ONR/N93-177

Passive Remote Sensing of Meteorological Parameters

Prepared by
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December 28, 1994

N00014-94-C-0037

Prepared for

Office of Naval Research
800 N Quincy Street
Arlington, VA 22217-5660

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16 Abstract (Limit: 200 words) This document presents the results of a Phase I Small Business Innovative Research (SBIR) initiative that examined possible sensing, communications and processing systems that could more adequately meet the extreme meteorological requirements of Special Operations Forces. The SBIR focused on the engineering feasibility and near term (1995-97) availability of these components to meet the operational realties and data requirements imposed by Special Operations requirements. The scope of the study was to examine systems that could augment the existing meteorological architectures and provide in theater sensing and processing capabilities to the already robust global weather distribution systems. The study focused on the satisfaction of mesoscale time and space meteorological requirements. The SBIR concluded that components exist over the next two years that could be integrated to provide enhanced meteorological support. The major obstacles to improved performance are data density in time and space, communication of data to a processing system and the speed and size of processing systems to operate at Theater levels. The function of assimilation and integration into forecast mesoscale models is proposed for theater level application. Output of gridded model parameters, as well as real-time sensor and satellite data, is proposed as a means of providing a more continuous and timely view of the battlefield environment. The gridded output would be transmitted to deployed forces for display via a "weather effects" system. Recommend development of a prototype systemand test bed consisting of available SOCOM METOC hardware modules, selected sensors, communications systems and processing systems (forecast models) to evaluate the performance, trade-offs and cost of an enhanced meteorological system.

17 Document Analysis a) Descriptors

b) Identifiers/Open-Ended Terms

c) COSATI Field/Group

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1.0 INTRODUCTION

This SBIR Phase I Final Report focuses on the unique subset of Passive Remote Sensing of Meteorological Parameters which specifically address Special Operations Forces (SOF) Meteorological and Oceanographic (METOC) requirements. Special Operations Forces levy stringent requirements on environmental sensing and reporting systems. These requirements span the environment from subsurface oceanic and waterway conditions to conditions at the top of the atmosphere. The premise of this SBIR was that satisfaction of SOF/METOC requirements could occur only through the integrated application of state-of-the art sensors, communications links and processing systems scaled to operationally relevant levels of operations.

1.1 Phase I Objectives

The objectives as described in the original proposal to conduct this Phase I effort were to:

1) Review and identify requirements for tactical weather systems as defined by USSOCOM users
2) Determine the types of components (receivers, processors, sensors, data sources and prediction tools) that support SOCOM requirements and are appropriate for integration into lightweight real time weather systems
3) Evaluate the components from the various Government and commercial sources and
4) Determine the most efficient way to integrate the selected components

1.2 Phase I Scope and Scale

This initial Phase I effort examined a broad range of sensing systems, communication means and processing platforms that might be used, in concert, to begin addressing the unique requirements of Special Operations Forces. The procedure adopted for this study was to compare the requirements with the existing systems that are being used to satisfy those requirements and to then evaluate new technologies that could enhance those systems.

1.2.1 Scope of the Study

The problems and complexities associated with improving meteorological awareness have been studied, systems have been developed, organizations established and procedures defined to provide the war fighting forces information to successfully accomplish their missions. The scope of this SBIR was to examine the meteorological support structure at the Special Operations support systems at theater level and below. The intent of the study was to look at new technologies that could enhance the capabilities of the theater level meteorological staffs and the support hey provide to their customers (customer group 2 described above).

1.2.2 Scale of the Study

The scope of the study was defined by organizational level. The scale of the study was extracted from a review of the required environmental parameters found in the Special Operations Forces Meteorological and Oceanographic Architecture Study, dated 29 October 1993 (referred to as the SOCOM METOC Study for the remainder of this report). The environmental parameters defined in that document impose time and space requirements to be satisfied by the meteorological support structure supporting Special Operations activities. Comparing these stated requirements to widely accepted meteorological scales of motion provide the physical time and space scales within which this Phase I study were loosely bound. Figure 1.2.2-1 shows the study boundaries as compared to these meteorological scales.

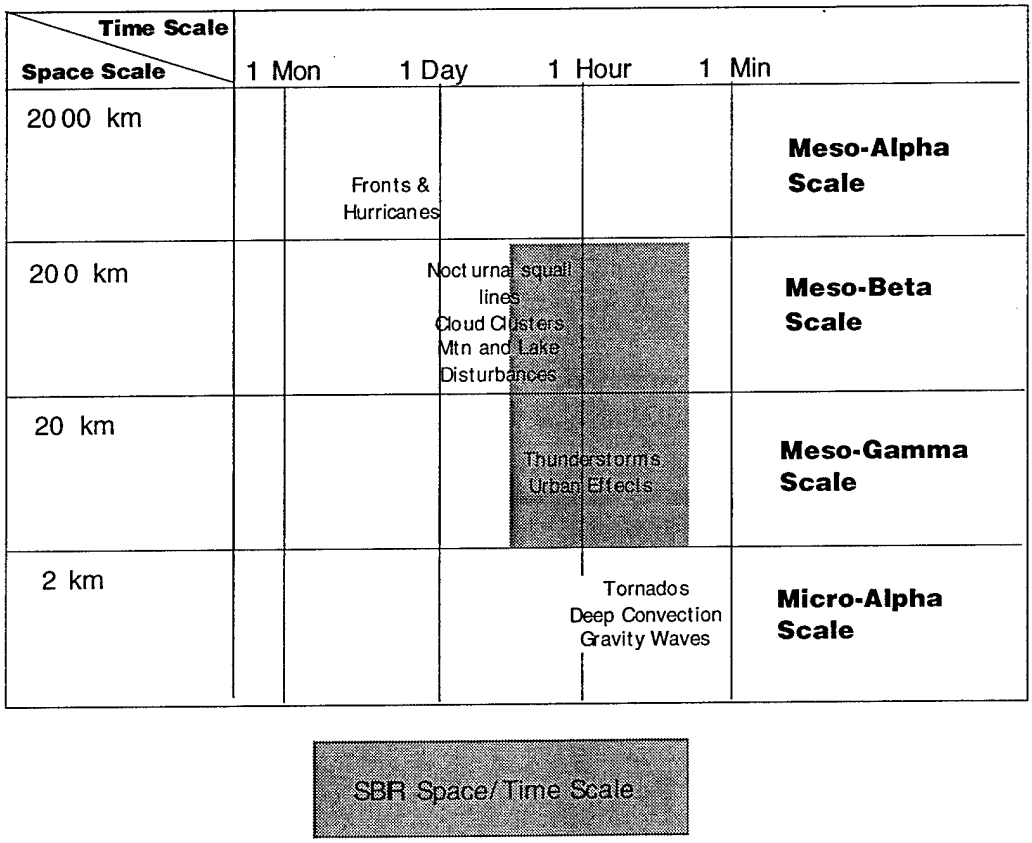


Figure 1.2.2-1 Meteorological Scales and the SBIR Study Area
(adapted from Orlanski, 1975)

1.3 Phase I Methods

Phase I activities followed the following steps:

1) Collect and review of Special Operations Forces meteorological requirements
2) Gather information on systems that could be applied to the requirements
3) Evaluate the suitability of systems to meet the meteorological requirements as well as the operational constraints of the customers
4) Apply the systems within the framework of the on-going SOCRATES (Special Operations Command Research Analysis Threat) METOC architecture.
5) Recommend systems for follow-on Phase II prototype deveopment and testing

1.4 Customers

This Phase I effort applies to two distinct environmental customer groups. The first group consists of weather support teams providing theater support to Special Forces activities. This group requires the data collection, assimilation and forecasting tools to support deployed forces. Their mission is to produce the highest quality weather products possible in support of their customers.

The second customer group are those deployed forces with weather information needs. These deployed forces may have limited communication and processing infrastructures and most likely no on-site meteorological support. This customer group is interested in mission accomplishment and are concerned about the weather only in the sense that it effects systems, friendly or enemy, that could determine the outcome of the mission. Through the remainder of this final report, "weather effects" products or displays are discussed. These products or displays describe the type of weather information that concern this second customer group, the deployed force.

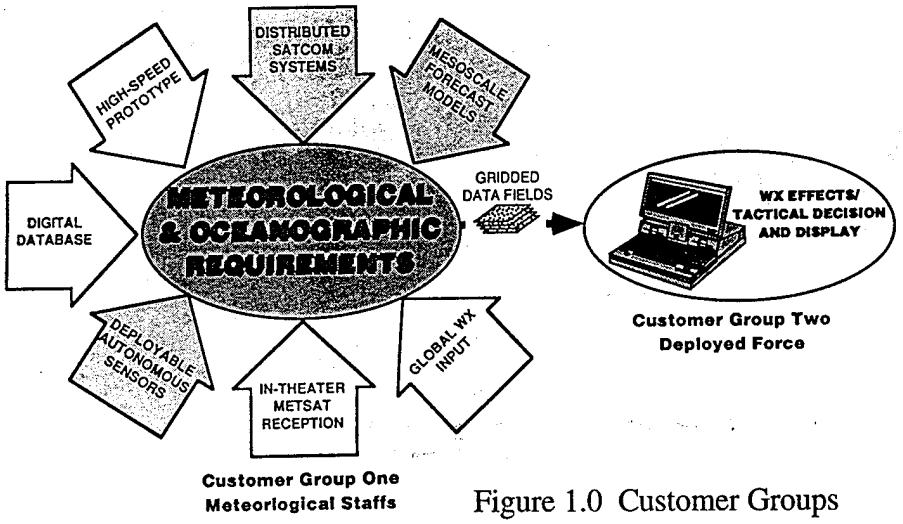


Figure 1.0 Customer Groups

This customer group distinction moved the SBIR beyond the initial objectives of evaluating just those systems that could enhance meteorological systems. The decision to include deployed force weather effects displays came from the realization that improved weather sensing and forecasting is of very little use if the information that results from those improvements is not delivered to the weather consumer. This designation of deployed force is generic in the sense that the deployed force could be a decision maker or planner colocated with the weather staff or a true deployed force with limited or no meteorological expertise.

1.5 Phase I Assumptions

The following assumptions were made for the purpose of this Phase I work:

1) The hardware and communication architectures described in the SOCOM METOC Study and the SOCRATES/METOC architecture represent baseline capabilities for weather support to SOF.

2) Communications from global weather centers to the Theater are in place and can provide global products to the Theater meteorological staffs.

3) Deployed forces have processing capabilities equivalent to a PC laptop or better.

4) Use of distributed satellite communications systems, either DoD or commercial would be approved for use in the theater.

It became clear early in the SBIR that, in order to achieve this objective, some type of advanced data assimilation and forecast production system would be required to meet or at least approach the stated requirements. Lacking continuous sensing and reporting over large areas of interest, an approach was selected that would require the installation of a network of sensors coupled to a high fidelity spatial and temporal forecast model. This forecast model generates gridded fields of atmospheric parameters. These gridded fields can be used as input to tactical decision aid products or weather effects products for direct use by the customer.

A wide variety of sensors were examined that could meet some of the environmental data requirements depicted in Appendix A. These sensors were evaluated based on their ability to meet the accuracy and timeliness requirements listed in the appendix and were compared against other similar sensors in the area of weight, cube and power consumption. The intent of the survey was not to produce a market survey of weather sensing systems but to determine the kinds of sensor that might lend themselves to integration into a deployable sensing architecture that could provide data feeds to a processing system. One of biggest impediments to the implementation of an in-theater sensing and forecasting system is the availability of data to support a more detailed view of the theater of operations.

1.6 Task Organization

Phase I of this SBIR was divided into six tasks:

Task 1 was to review current USSOCOM weather information and BM/C4I interface requirements for tactical weather systems. The primary sources of information regarding these requirements were the SOCOM METOC Study, personal interviews with LtCol Coleman, the Air Force Special Operations Command (AFSOC) meteorological branch chief and LCDR Clendening and LT Mathews, the Navy meteorological support to the Special Operations Command Joint Intelligence Center (SOCJIC) from COMNAVMETOCOM. The communications and hardware architectures were defined by the evolving SOCRATES/METOC architecture provided to the study team by AFSOC weather.

Task 2 was to determine what components (receivers, processors, sensors, data sources and prediction tools) support US SOCOM requirements and would be appropriate for integration into an ultralight, real-time weather systems. During FY1994, SOCOM began procuring components of a SOCRATES/METOC architecture. A description of these components can be found in Section 2. The sensor components, communications systems and processor requirements evaluated by the SBIR team were compared to the existing and planned modules of the METOC architecture to ensure compatibility.

Task 3 was to evaluate the component types from various Government sources and commercial vendors. This evaluation of off the shelf or in the lab products was particularly challenging given the expansive and stringent operational and data sensing requirements of Special Operations Forces.

Task 4 was to investigate and determine the most efficient and feasible approach to component integration and testing. Efficiency was subjectively considered based on the location of components described in the METOC architecture, the data and product flow among the METOC components and the processing capabilities resident at the METOC operating nodes. Feasibility was considered throughout the study, manifesting itself in the evaluation of power, weight and cube characteristics of sensors, processors and communications devices. Feasibility must also be considered as Phase 2 experiment efforts begin.

Task 5 was to develop a road map, based on our findings, to determine the best approach to support USSOCOM's tactical system weather requirements. Included in this road map will be a recommended design for the Phase II prototype system to be fielded and tested. Task 5 was not implemented during the task but will be included in the Phase 2 proposed efforts.

Task 6 was to produce a final report documenting Phase I activities and results.

1.7 Report Organization

Section 2 of this report presents a compilation of the SOF support requirements and constraints as derived from the Special Operations Forces Meteorological and Oceanographic Architecture Study, Reference 1 and the supporting meteorological system architecture.

Section 3 discusses the systems and components evaluated to provide enhancements to the existing and planned meteorological architectures. Included in this section are data source considerations, communications means, processor options and processing functions that could be used to more adequately address the meteorological requirements shown in Appendix A.

Section 4 provides an overview of the systems evaluated in section 3 as they could be applied to the existing architectures to include a notional exercise support activity.

Section 5 presents the Phase I conclusions and recommendations.

Appendix A lists the SOCOM METOC Study requirements .

Appendix B lists Sensors and Systems found to be available during the period of this SBIR and lists the Section 2 requirements potentially satisfied.

Appendix C lists the Vendor or Provider Addresses who can provide the sensors and systems listed in appendix B.

The SBIR bibliography concludes the report.

2.0 SOF SUPPORT REQUIREMENTS AND CONSTRAINTS

Accurate and timely METOC information is vital to the successful conduct of Special Operations missions both in the early planning stages and during conduct of operations. The extreme time, space and accuracy requirements for data and the operational constraints of deployability and implementation of system architectures present significant challenges to system development. These extreme requirements and constraints are not unique to SOF. Almost all military operations across the services are characterized by a requirement for large amounts of useable information and little tolerance for large information systems to support the operation. Examples in the meteorological support area include the move from large weather satellite receive vans/shelters to small tactical terminals in desktop computers and the installation of small weather satellite receive systems on ships that cannot accommodate tracking antenna systems.

The challenge of providing meteorological information systems and data support for SOCOM has been addressed by a number of customers, most recently through the SOCRATES/METOC initiative. Global weather centers have built products and distribution systems to provide support to deployed weather support staffs. This feasibility study provides for the continued exploitation of these products, dissemination systems and hardware and software architectures but moves beyond them to evaluate the use of systems that provide a more detailed and timely environmental picture. The study examined those systems and capabilities that are expected to be available over the next two years that can enhance the existing and proposed architectures through the application of sensors, communications systems, advanced in-theater processors and processes.

2.1 The SOCRATES/METOC Architecture.

The planned weather support architecture for Special Operations Command has been constructed based on an intelligence systems support architecture called SOCRATES. The SOCOM meteorological support staff, led by Air Force Special Operations Command (AFSOC) proposed a meteorological variant of the SOCRATES architecture and called it SOCRATES/METOC. Figure 2.1-1 shows the architecture as currently envisioned. The scope of this SBIR focused attention on the two systems shown as laptop type computers in the figure. The file server system with the data feeds from the Automated Weather Network, Radar, METSAT and Graphics is outside the scope of the study. Data from that system is assumed to be available to the lower level systems.

AFSOC has initiated acquisition activities to procure components of the SOCRATES/METOC architecture and expects these activities to extend over a period of five years. The system components, or modules as described by AFSOC, will provide enhanced meteorological support

to the first customer group, and, by improving their performance, indirectly provide enhanced support to the second customer group. These hardware and software modules are included in this study and are described in the next section. The general SOCRATES/METOC architecture was followed in this SBIR with a conceptual modification that takes the laptop shown as SATRCVR in Figure 2.2-1 (Module I) and puts it in the hands of the second customer group, the deployed force. The Module is enhanced with a weather effects display device and automatic ingest of forecast gridded data fields. The ethernet connection shown between the Man Transportable System (MTS) (Module II) and the laptop is replaced with communications links described in Section 3.4. This extension of the SOCRATES/METOC architecture beyond the meteorological community is required if delivery of meteorologically time sensitive information is to be used for the conduct of operations. It is unreasonable to assume that meteorological support personnel will be deployed as part of every Special Operations mission. There exists a requirement therefore to provide products to the deployed forces that match their time and space scales of interest. The SBIR team assumed that the time and space scales that are of interest to the deployed force match the time and space scales explicitly stated or implied by the Appendix A requirements.

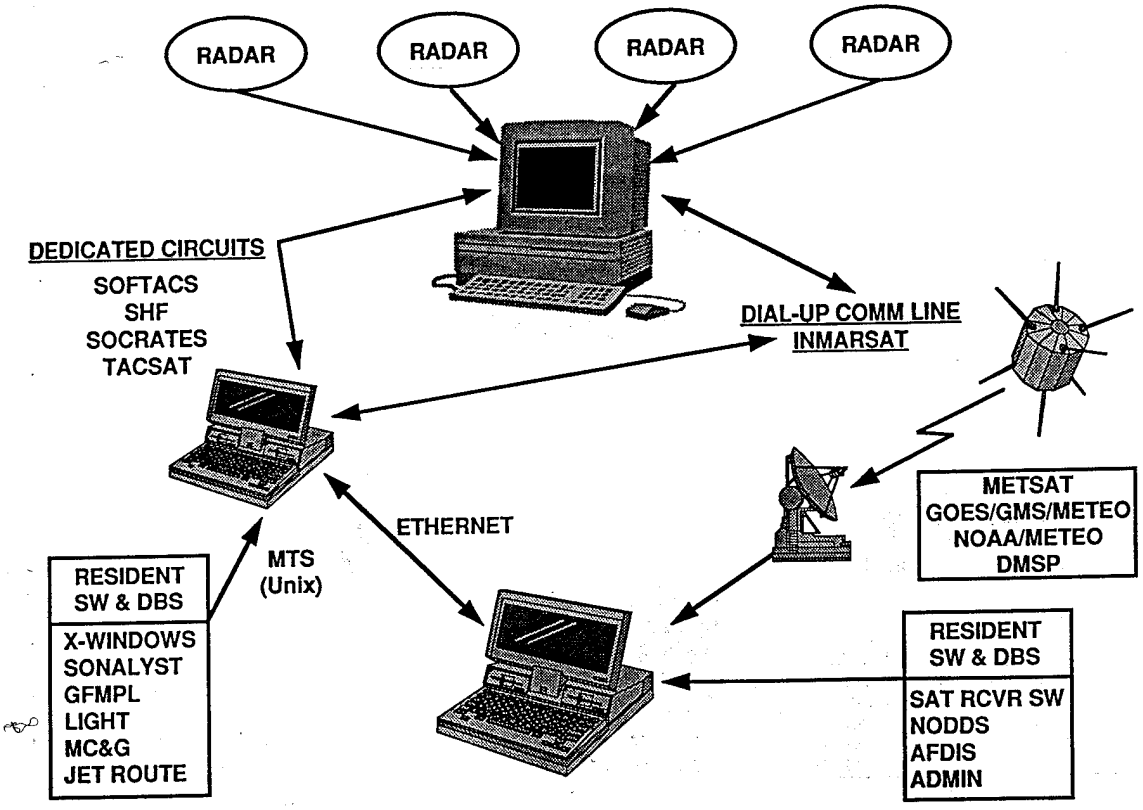


Figure 2.1-1 SOCOM Meteorological Data Feeds and the SOCRATES/METOC Architecture

Procurement of the SOCRATES/METOC architecture is scheduled to be completed by modules. Four modules are currently planned. Module I is depicted as the laptop SATRCVR in Figure

2.1-1. It is envisioned to provide low resolution weather satellite reception and data links to global telephonic data distribution systems. Module II is projected to be a notebook UNIX based system with a commercial software package called Sonalysis, that provides an environment for the display and manipulation of gridded data fields and other geographically referenced data. Module III is a high resolution geostationary weather satellite receive segment and Module IV is a high resolution polar orbiting weather satellite receive segment. The data and imagery received by module I, III and IV are described in section 3. The module numbers indicate the relative acquisition sequence of the modules. As additional modules are procured, the capabilities resident from earlier modules will be retained. The data sources indicated at the top of Figure 2.1-1 are assumed to be available and are therefore considered available to the theater level forces.

The tables of meteorological requirements, oceanographic requirements and planning factors from Reference 1 include data accuracy and refresh requirements. The approach taken for this SBIR was to examine all the requirements or factors regardless of stated or unstated accuracy requirements. For those requirements or factors without stated accuracy requirements a quantitative evaluation of the sensor performance was not performed. Appendices B and C contain tables of sensors and equipment that were catalogued and entered into a data base where they are cross referenced to the SOF requirements referenced in Appendix A.

2.1 Planning Factors

Environmental planning factors which supplement the METOC parameters mentioned in 2.0 are listed at the end of Appendix A. While the planning factors may not fit the generally excepted definition of METOC data, they represent information required for planning purposes to support Special Operations Forces. Many of the parameters listed in the Sea Floor and Coastal/Riverine Conditions tables are generally considered Hydrographic parameters and are therefore considered to fall within the MC&G domain. Collection and processing of Hydrographic data represent a large, on-going program at the Naval Oceanographic Office. Responsibility for these parameters with respect to SOF METOC support needs to be clearly defined and assigned.

2.2 Organizational Factors

The lowest level of support to USSOCOM is the Special Operations Weather Team - Tactical Element (SOWT-TE) consisting of three weather NCO's per team. It is assumed that these personnel will be attached to a deployed JSOTF within a theater of operations. Two of these teams will be available to support two simultaneous deployments within the JSOTF area of interest. One or more of these weather NCO's may or may not deploy into the field with the STS or WETM on special missions. The remaining team members would be available to perform local forecasting and relay of important weather data to the team in the field using information

forwarded to them from higher echelons within the weather community or received on site from available resources. This action should be coordinated with relay of other required information to the deployed mission team.

2.3 Operational Constraints

2.3.1 Joint Special Operations Task Force (JSOTF)

The JSOTF is assumed to have semi-permanent facilities including electrical power, tables and chairs, and all the modules of the SOCRATES/METOC architecture described above. Communications links to global weather centers and services is provided to the SOCRATES/METOC hardware via dedicated SOFTACS, TACSAT, SOCRATES, and SHF equipment. This facility is also assumed to have some set of the following capabilities: dial-up capability to Fleet Numerical Oceanographic Center via the Naval Oceanographic Data Distribution System (NODDS), dial up capability to Air Force Global Weather Central via the Air Force Dial In SubSystem, Environmental Technical Applications Center databases, NAVOCEANO, Theater Headquarters or other higher echelon and a possibly a local radar installation.

2.3.2 Special Field Units

Any special forward observer or data collection platforms as recommended in Phase II of this SBIR for use by the SOF mission deployed teams forward of the JSOTF level must be man transportable, simple to set up and operate and must be of low power consumption, capable of battery operation and, for extended missions or unattended operation, capable of solar recharging.

2.4 Potential System Enhancements

The orientation of the SOCRATES/METOC architecture is to provide full exploitation of meteorological data from central facilities and provide a real-time satellite receive capability to the deployed meteorological support staff. This support staff is generally confined to the JSOTF level where communications links to the central data sources are available.

This SBIR operates in a domain that is at the JSOTF level and below. The emphasis was on systems and processes that could be accomplished at time and space scales that could not be satisfied with centrally produced output. The possible system enhancements that were considered during this SBIR and that will be described in more detail in section 3 include:

1) A more dense in-theater sensing network (space and time)
2) A data assimilation system that can ingest a variety of meteorological data sources and time sequence them into a forecast model
3) A mesoscale forecast model that can operate using boundary conditions provided from global data outputs and sensor data sources within a theater
4) A weather effects display system that can automatically ingest the output of the mesoscale models and produce a weather information display at the selection of a weather user (not necessarily a meteorological staff section)

3.0 SYSTEM COMPONENTS

Improvements in the SOCRATES/METOC architecture can be obtained through the application of enhanced data sources, exploitation of meteorological products from global centers, improved communications for meteorological systems employed below the JSOTF, application of advanced data assimilation and mesoscale forecast models and weather information displays that provide a weather user the ability to exploit the enhanced meteorological picture. This Phase I SBIR examined the data feeds, communications systems, processors and processing components that could be used to enhance satisfaction of Special Operations Forces requirements. Figure 3.0-1 depicts the major contributors to the environmental sensing and processing solutions for SOCOM. This study concentrates on the hardware, sensors, forecast models, metsat reception and weather effects/tactical decision aid aspects of the problem.

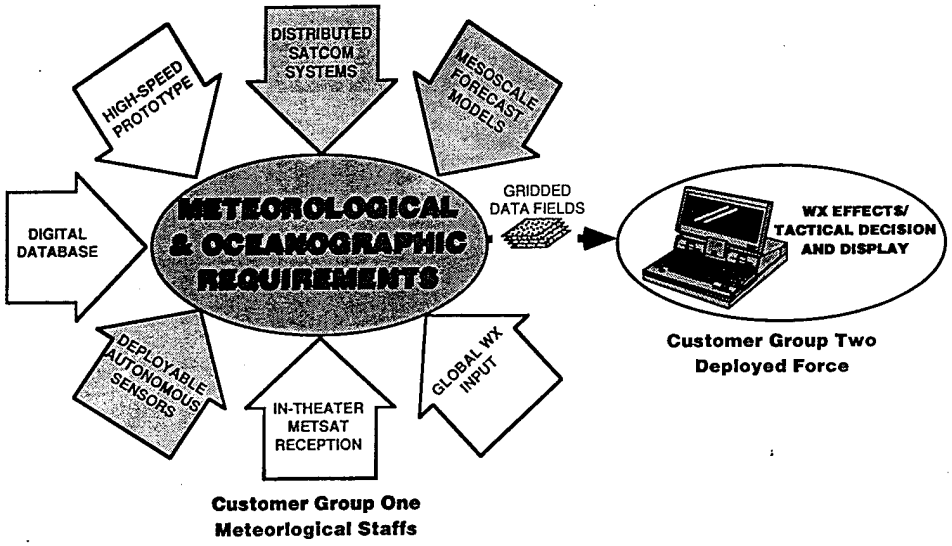


Figure 3.0-1 - Conceptual Meteorological System Inputs and Output

Each of these possible areas of improvement were examined during the Phase I SBIR and are described in the following sections. Recommended system improvements are included in section 5.0.

3.1 Data Sources

3.1.1 Meteorological and Oceanographic Space Based Sensors

Space based meteorological and oceanographic sensors provide the only means of broad area coverage of a theater area of interest at spatial scales of interest to Special Operations Forces. Only recently have small weather satellite receivers and processors been used by deploying forces in the SOF community. Many meteorological systems now have, or are projected to have,

the capability to receive geostationary imagery from civil and foreign satellite broadcasts as well as direct downlink imagery from civil, foreign and DoD weather satellites. The SOCRATES/METOC architecture includes this as part of Module 1 (low resolution civil weather satellite imagery (US TIROS and Russion METEOR Automatic Picture Transmission (APT) and Geostationary Weather Facsimile (WEFAX)), Module III (Geostationary High Resolution Imagery such as Stretched VISSR broadcasts, and Module IV (High resolution polar orbiter direct broadcasts (US TIROS High Resolution Picture Transmission (HRPT)). These procurement plans will provide weather satellite data ingest capabilities needed for improved systems support. However, satellite imagery and data are limited in a number of critical areas. Some of the limitiation are:

1) The size of high resolution receive, storage and processing systems (particularly Geostationary Stretched VISSR)
2) The relatively large gaps in time between passes of the polar satellites
3) The inherent inability of space based systems to provide detailed boundary layer information or information below the top cloud layers.
4) The lack of global coverage from US geostationary satellites

There are two primary types of meteorological satellites and two distinct communities that build and operate these satellites. The types of meteorological satellites are polar orbiting sun-synchronous satellites (e.g TIROS, DMSP, METEOR) and geostationary satellites (e.g. GOES, GMS, METEOSAT and INSAT). These satellites are described below and are reviewed for their ability to provide data for use in the SOCOM system.

3.1.1 Defense Meteorological Satellite Program (DMSP)

The DMSP is a series of High Resolution Polar Orbiting medium altitude (450 nm) Military Environmental/Meteorological Satellites in sun-synchronous, near polar orbits supplying world wide coverage every 12 hours. The nominal configuration is two operational satellites; one "morning" orbit crossing the equator northbound at 0600 to 0700 local time, and one "noon orbit" crossing the equator northbound at 1000 to 1130 local time. Currently there are five satellites in orbit, the latest three of which utilize encrypted commands and S-Band data downlinking. The satellites are equipped with sensors that perform visible, infrared and microwave imaging, microwave sounding and space environmental sensing. The primary earth sensors are:

Operational Linescan System (OLS)

Band	Resolution
Visible	0.6 km
Infrared	0.6 km
Night vis	3.5 km

Microwave Imager/Sounder (SSMIS)

Imagery	12-15 km
Soundings	50-100 km

DMSP is an end-to-end system that includes space, ground and user segments. The ground and user segments are trailer/van mounted, with large decryption devices and have limited usefulness in forward areas. A smaller receive segment is being acquired by the DMSP Program Office that will receive DMSP and other civil and foreign satellites.

3.1.2 TIROS (Television Infrared Observation Satellite)

The TIROS series of environmental satellites is a cooperative NASA and NOAA program consisting of 13 satellites currently on orbit with 4 more scheduled to be launched. The TIROS satellite is a rough civil equivalent to the DMSP satellite described above. The orbital characteristics are similar with TIROS satellites separated into a morning and afternoon pass satellites

All TIROS satellites are equipped with Advanced Very High Resolution Radiometers (AVHRR) and TIROS Operational Vertical Sounder (TOVS) instrument packages. The AVHRR produces various real-time and recorded High Resolution (1.1 km) HRPT and Low Resolution APT imagery, and the TOVS includes a Microwave Sounding Unit (MSU), a Stratospheric Sounding Unit (SSU), and a High Resolution Infrared Radiation Sounder Model 2 (HIRS/2).

The AVHRR is a scanning radiometer, sensitive in five spectral regions for the currently available NOAA 9, 10, 11, and 12 satellites. (Older satellites were sensitive to only four spectral regions)The HRPT data format includes all five of the AVHRR spectral data channels, with IR wavelength response as follows:

Channel 1: 0.58-0.68 microns
Channel 2: 0.725-1.10 microns
Channel 3: 3.55-3.93 microns
Channel 4: 10.3-11.3 microns
Channel 5: 11.5-12.5 microns

TIROS includes two direct real-time transmission modes, Automatic Picture Transmission (APT) and High Resolution Picture Transmission (HRPT). The APT broadcasts two of the AVHRR channels selected by the National Environmental Satellite Service (NESS) Spacecraft Operations Control Center (SOCC). Normally, the APT broadcast includes Channel 1 and Channel 4 during the daylight side of the pass and Channels 3 and 4 during the nighttime side of the pass. Module 1 of the SOCRATES/METOC architecture receives the APT broadcast. The HRPT broadcasts

all five spectral image channels and the TOVS data. The HRPT reception capability is included as part of SOCRATES/METOC Module IV.

An incremental addition was a Search and Rescue Demonstration System (SAR) referred to later in this document as the Data Collection and Location System (DCLS) as a payload, and ARGOS as a total system including the ground processing facilities.

The low bit rate data from the TIROS Information Processor (TIP) has used its spare words for special instruments such as the ERBE and SBUV/2. The SAR system (DCLS) is independent, utilizing a special VHF frequency for transmission of data to the ground. In recent years, the increasing ambient radio frequency noise level in the VHF spectrum has reduced the performance of the downlink in metropolitan environments. Even with the most advanced ground station hardware and software used to minimize the level of interference experienced when receiving the low-power VHF TIP beacon transmitter from the TIROS satellites, the received bit error rate has continued to increase to a level which is unsuitable for many purposes.

3.1.3 Geostationary Satellites

Geostationary meteorological satellites are maintained at Earth synchronous altitude (35,800 km) in the equatorial plane, maintaining a constant position relative to their location on the Earth's surface. Each spacecraft is controlled for proper Earth imaging by an attitude control subsystem which maintains the spin rate at approximately 100 rpm and aligns the spacecraft spin axis perpendicular to the Earth's equatorial plane. The United States, Japan, the European Space Agency and India operate geostationary weather satellites. The United States operates two Geostationary Operational Environmental Satellites (GOES), and the Europeans, Japanese and Indians operate one each. These satellites are nominally positioned at 135W, 75W, 0, 70E and 135E respectively. Like the polar weather satellite, geostationary satellites have a number of transmission modes. The two direct broadcast modes include a rebroadcast channel called WEFAX (for weather facsimile) and a direct real time transmission. The direct real time transmission varies from satellite to satellite. The WEFAX broadcast is consistent in radio frequency broadcast and product format but not in the types of products broadcast by the individual satellites. India does not provide a WEFAX broadcast from their satellite. WEFAX is the primary geostationary imagery broadcast exploited by DoD weather systems including Special Operations.

SOCRATES/METOC Module I includes a WEFAX receive capability. SOCRATES/METOC Module III provides for connectivity to the real time high resolution broadcast from this class of weather satellites. SOCRATES METOC module III, which has not been procured, will provide a high resolution geostationary satellite downlink to the theater level. This high resolution downlink will require a relatively large antenna (approximately 12' aperture diameter) and more

substantial ground processing. For this reason this downlink is not projected for use in this Phase I SBIR.

3.1.3 .1 Geostationary Operational Environmental Satellite (GOES) System

The GOES System consists of 2 operational GOES geostationary weather satellites located at 135 degrees west longitude covering the western two thirds of the continental USA, Hawaii and most of the Pacific Ocean and at 75 degrees west longitude covering the eastern continental USA, eastern Canada, Central and South America and most of the Atlantic Ocean. It also includes a complex network of ground based tracking and control, data collection and dissemination facilities under the control of the US Department of Commerce National Oceanic and Atmospheric Administration (NOAA), and specifically, the National Environmental Satellite, Data, and Information Service (NESDIS).

The United States is currently transitioning from a spin stabilized GOES satellite to the new GOES Next system. GOES-8 launched in Summer 1994 is the first of the new three axis stabilized systems. GOES-9, which is scheduled for launch in the Spring of 1995, will complete the changeover from the spin stabilized constellation.

Cloud and temperature imaging in both visible and infrared (IR) spectra is accomplished through the Visible Infrared Spin-Scan Radiometer Atmospheric Sounder (VAS). The mapping raster is formed by the combination of the satellite spin motion (spin-scan) and step action of the scanning optics. One raster line in the Earth's West-East direction is formed for each revolution of the spinning satellite at each North-South angular scan step position of its scan mirror. The VAS will provide both day and night two-dimensional cloud and Earth mapping capability with a satellite subpoint resolution of approximately 0.9 km for visible imagery and 6.9 km for IR imagery. The VAS has six IR detectors, two for imaging and four for sounding information. The VAS will also obtain radiometric data in the Earth's atmospheric water vapor and carbon monoxide absorption bands providing the capability to determine the three-dimensional structure of atmospheric temperature and atmospheric water vapor distribution. The arrangement of the detectors facilitates the several imaging modes of the VAS.

In the operational Visible and Infrared Spin Scan Radiometer (VISSR) mode, data from the visible and IR detectors are transmitted on every scan line. Filter wheel position and frame size are controlled by time-synchronized command link. By selective use of filters in combination with detectors, and by interweaving scans of large and small detectors a full frame of scans can image the Earth in as many as three IR spectral channels. The field of coverage for this mode is 20 degrees N-S by 20 degrees E-W. A complete image takes 20 minutes. The VAS is programmed to start a new image in 30 minute intervals. The remaining 10 minute interval between images is used for Weather Facsimile (WEFAX) transmissions and ranging.

A limited area coverage mode is available and is used for obtaining special data during weather emergencies and for experimental purposes. More frequent coverage of a particular area can be obtained in this mode.

3.1.3.2 Geosynchronous Meterological Satellite (GMS)

The GMS system is a Japanese Geosynchronous Meteorological Satellite positioned at 135 degrees East Longitude. The Japanese satellite is a spin scan satellite providing full disk earth imagery every thirty minutes. The Japanese satellite rebroadcasts products through its WEFAX broadcast system. These broadcasts can be received by Module I of the SOCRATES/METOC architecture.

3.1.3.3 METEOSAT

The METEOSAT system is a European Geosynchronous Meteorological Satellite positioned at Greenwich meridian (0 degrees Longitude). Its coverage and data outputs are also compatible with the US GOES system.

3.1.4 SeaWiFs/SeaStar System

The Sea-Viewing Wide-Field-of-View Sensor was developed by Hughes' Santa Barbara Research Center under subcontract with Orbital Sciences Corporation, who, in turn was under contract with NASA and EOSAT to obtain measurements of the spectra of sunlight reflected from ocean waters. These measurements are important in determining the concentrations of chlorophyl and phytoplankton in the oceans of the world. The SeaWiFs instrument will be carried by OSC's SeaStar satellite and is expected to be launched in early 1995 by the Pegasus launch vehicle. The satellite will orbit at an altitude of 705 km providing a scanned swath of 2800 km with daily earth coverage. Although this system is not a meteorological satellite, it produces output in the same format as the TIROS HRPT data format and can be received using a receiver designed for capture of TIROS imagery. The payload will measure the color spectra in eight optical wavelength bands from 402 to 885 nanometers. These additional multispectral bands may prove useful as input to the forecast models discussed in a later paragraph of this report.

3.1.5 Airborne Sensors

The sensors addressed in this section consist of those sensors whose positions are between the earth's surface and the top of the earth's atmosphere and do not include orbital sensors or those below the earth's surface.

3.1.5.1 Unmanned Aerial Vehicle (UAV) Sensors

UAV's offer the potential to deliver oceanographic dropsonde payloads and future miniature dropsondes with monitoring accomplished by TIROS/ARGOS and Aircraft Carrier Platforms equiped with Tactical Environmental Support System (TESS). Sensors could also be placed on Aerostat balloons should they be available as a sensing platform.

3.1.5.2 Piloted Aircraft Automatic Sensing.

While automatic weather data relay from piloted aircraft are not currently in use, much of the data needed by meteorological personnel are available in the aircraft and used for various other purposes. For example, many inertial navigation systems and flight data computers calculate and make available to various systems on board the aircraft quantities such as wind speed and direction, aircraft altitude and position, air temperature and other quantities, which, if relayed to the local weather station automatically, as a group, in near real time could be used to improve the quality of the high fidelity weather forecasts for the surrounding areas. These concepts have been implemented on commercial aircraft and have provided very useful data that can be merged with other conventional observations for use as data input to a forecast model.

3.1.5.3 Pilot Reports (PIREPs)

PIREPs are weather reports submitted by commercial and military pilots in real time via voice communication to air traffic controllers. These reports may be useful but without some automated method of introducing them into a processing element they may become difficult in incorporate. The pilot reports may be more directly useful to the meteorological staff to adjust forecasts that are prepared based on automated data sources.

3.1.6 Surface Sensors

Sensors in this category are located immediately above the earth's surface, and measure the atmospheric conditions at this location. SOF tactical METOC observation equipment must be highly transportable, rugged, and accurate. Automated tactical remote sensing equipment which satisfies SOF METOC support requirements is needed. This SBIR explores some of those possibilities.

An extensive market survey of surface sensors was performed to determine what sensors were available to potentially satisfy the various requirements of the USSOCOM Meteorological and Oceanographic (METOC) Architecture Study, 29 October 1993, (reference Appendix A). Surface sensors were not available for all applications of the METOC information needs. Appendix B is a complete listing of the 525 sensors evaluated for this study. The following sections give brief descriptions of sensors types and how they operate. Later sections discuss the results of the study itself.

3.1.6.1 STUDY METHODOLOGY

Sensors were categorized first by METOC requirement. Then the sensors were mapped against the METOC accuracy requirement. Those sensors not meeting the minimum requirement were eliminated from the study although they remain in the appendix. The remaining sensors were then sorted by weight and then by volume. The top three sensors, including sensor features and physical attributes, of each category are listed in the tables below.

To further explain the tables in this section and the sensors listed in Appendix B qualifications are necessary.

1) Not all data was available for all sensors shown. When a sensor looked like it could satisfy a requirement it was included regardless of missing data.
2) Because not all manufacturer brochures had the required information, some sizes and weights were estimated. This was done to give the reader a sense of whether the sensor could be carried in to a remote area or would need to be trucked or airlifted.
3) It became evident during the study that some manufacturers used the same identical sensor only packaged the sensor under different names. As this was detected duplications were avoided where possible.
4) Accuracy is plus or minus the percent shown.
5) The system field is an indicator whether the sensor performs one (00) or more than one (0#) function. It was used by the authors of this report in the evaluation process but was not intended for future use.

In addition to individual surface sensors, weather systems were also evaluated. Many of the systems are relatively small, lightweight and can perform multiple basic measurements. The weather systems discussion follows in Section 3.. A full listing of the weather systems reviewed in this study is located in Appendix C of this document. Further, the names and addresses of the manufacturers used in this survey are shown alphabetically in Appendix E.

3.1.6.2 SURFACE SENSORS

3.1.6.2.1 Altimeter Setting

The altimeters included in this study are small hand-held devices to suit the requirements of a foot soldier. Of the ten models researched, all meet the accuracy requirement in Hg, mb and ft. Most of the altimeter sensors also include pressure and operate, as minimum, between +5 to 40 deg C. The AIR Intellisensor requires 8 to 16 Vdc and a data logger or computer to display the information. The Scientific Sales altimeter, although less accurate, is self-contained and requires

only a 9V battery. The breakdown of the top three candidates and their weight, volume and accuracies by unit are listed below.

Reference 3.1.1.02, Altimeter (Hg, mb, ft)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
AIR	DB-1A	.59	553.7	.01 Hg
Scientific Sales	AIR-HB-1A	.28	395.9	.02 Hg
AIR	DB-1B	.59	553.7	.02 Hg
AIR	DB-1A	.59	553.7	.30 mb
Scientific Sales	AIR-HB-1A	.28	395.9	.50 mb
AIR	DB-1B	.59	553.7	.50 mb
Scientific Sales	AIR-HB-1A	.28	395.9	1 ft
AIR	DB-1A	.59	553.7	8 ft
AIR	DB-1B	.59	553.7	13 ft

3.1.6.2.2 Barometric Pressure

Of the fifty barometers investigated 33 meet the METOC accuracy requirement. Sizes range from small hand-held devices to multisensor systems. The Paroscientific 740 and 760 series barometers are both small, precision measurement devices. The 760 is ruggedized and includes a tough but lightweight case. The 760 offers a built-in rechargeable battery that provides up to 200 hours of continuous operation. The Handar barometer and pressure sensor uses digital barometers for longer reliability and dual diaphragm sensors. The barometric sensor requires a data logger for the readout display. A diagram of an analog barometer is shown in Figure 3.1.6.2.2-1. The breakdown of the top three barometer candidates and their weight, volume and accuracies by unit are listed below.

Reference 3.1.1.05, Barometric pressure (mb)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Paroscientific	740, 760 Series	.91	1567.1	.01%
HANDAR	Baro/Press Sen	.26	311.6	.05mb
Qualimetrics	7100	.40	449.1	.05%

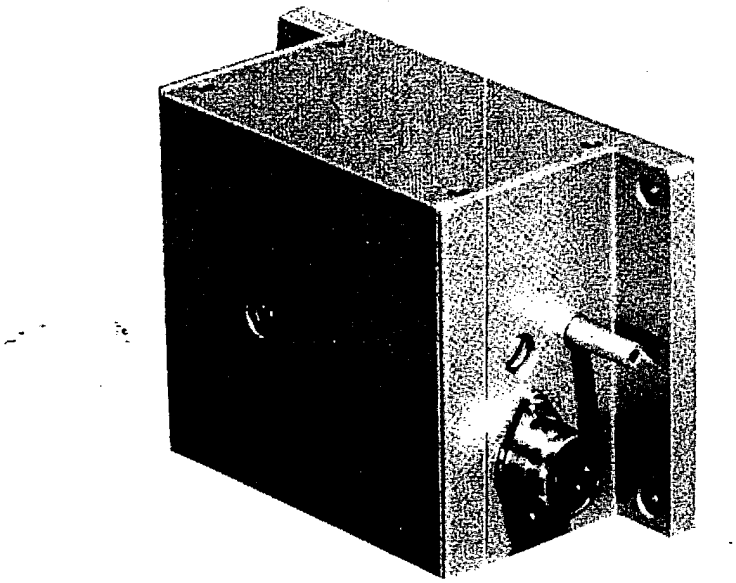


Figure 3.1.6.2.2-1 Analog Barometer

3.1.6.2.3 Cloud Base Height

For the purposes of this study, there are only three systems under investigation for the cloud height requirement. All three devices meet METOC standards. Vaisala's laser ceilometer measures up to 12,500 feet in fog, haze and rain with better than 7 meter accuracy. All of the laser ceilometers under consideration are large, bulky instruments best suited for long-term or permanent installation. The sensors require 115 or 230 Vac lines and interface to strip chart systems or a laptop computers. Below are the three ceilometers and their specifications.

Reference 3.1.1.07, Cloud Base Height (m)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Vaisala	CT12K	60.00	179282.1	6.1 m
Handar	450	39.54	207421.9	15.0 m
Qualimetrics	8329	61.30	247354.0	N/A

3.1.6.2.4 Relative Humidity

Thirty-four humidity sensors and sensor combinations are listed in Appendix B. Several of the sensors do not have stated accuracies. Because of the large number of manufacturers under this category sensors with stated accuracies are the sensors considered first. In general, the manufacturers combine, as a minimum, temperature with humidity in one sensor. NovaLynx offers two lightweight and very accurate models. The manufacturer recommends the sensor be mounted in a solar radiation shield for outdoor use. The temperature sensors are available for

use in air, water and soil. A diagram of a remote reading relative humidity sensor is shown in Figure 3.1.3.2.4-1.

NovaLynx	2046RH	.28	66.6	1.0%
NovaLynx	230-504	.28	66.6	1.0%
Scientific Sales	41372	.10	38.5	2.0%

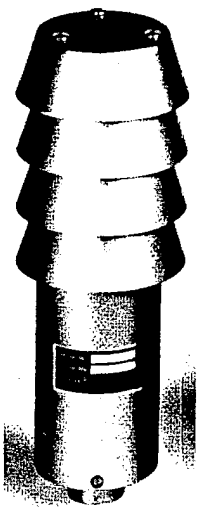


Figure 3.1.6.2.4-1 Remote Reading Relative Humidity Sensor

3.1.6.2.5 Illumination

Illumination sensors are limited in this study. Most of the sensors do not have accuracies stated but are considered anyway because of the limited number of samples available. The Scientific Sales sensor considered for this requirement is a lightweight hand-held device. It uses a selenium photocell to measure the illumination over desired ranges and indicate the information on a digital display in footcandles or lux. The portable device requires a 9V battery. The Li-Cor sensors albeit portable are larger than the Scientific Sales 3311 and require a readout device. The Li-Cor sensors can operate up to eight hours on a 6V Ni-Cad rechargeable battery.

Reference 3.1.1.22, Illumination (ftcndls)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Scientific Sales	3311	.25	342.3	5.0%
LI-COR	LI-210	.03	11.3	N/A
LI-COR	LI-1800	6.40	11794.7	N/A
LI-COR	LI-1800UW	25.00	22519.0	N/A

3.1.6.2.6 Lightening/Thunderstorms

Two lightening sensors are included in this study. The most accurate, Qualimetrics' Electrical Storm Identification Device (ESID) is rugged, solar-powered, and omni-directional. The storm station is immune to storm damage and weather extremes. ESID provides data to a display up to 100 meters away. Note, however, the display requires its own power source. Handar offers a rugged, low maintenance sensor. In addition to standard strike measurements, the sensor measures and stores amplitude and shape data for flashes within a specified time and computes the ranges of the thunderstorm on an octant-by-octant basis.

Reference 3.1.1.27, Lightening/Thunderstorms (mi)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Qualimetrics	ESID	N/A	155234.6	.01%
Handar	420A	36.00	155234.6	10.0%

3.1.6.2.7 Precipitation Accumulation

Several precipitation accumulation sensors are included in the study. Many of the thirty-three sensors do not have the stated accuracies or state them in percentages rather than centimeters. The top three sensors in this category are well within the accuracy requirements. Sensor types vary from tipping buckets to capacitance probes to pressure transducers. The 6731 collects and measures precipitation without moving parts. The capacitance probe provides a calibrated voltage output proportional to collected precipitation. For example, 0 to 5 Vdc = 0.50mm. The Young model, albeit larger, operates in the same way. NovaLynx was the only manufacturer examined to have a sensor to measure frozen precipitation accumulation. The data is shown below.

Reference 3.1.1.28, Precipitation accumulation (cm)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Liquid:				
Scientific Sales	6731	2.50	5954.6	.10 cm
Young Meteorolog.	50202	2.50	100006.0	.10 cm
Scientific Sales	6021B	3.60	15413.1	0.5 %
Frozen:				
NovaLynx	6041-B	10.20	48174.4	.50 %

3.1.6.2.8 Precipitation Rate

Three sensors/systems measure precipitation rate. The accuracies of these sensors are not available or not in the desired unit. Due to the limited number of these types of sensors all are being considered in this study. The sensors range from small hand-held devices to the slightly larger WIVIS Scan system.

Reference 3.1.1.29, Precipitation rate (cm)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Liquid:				
Handar	4440PT	2.27	6946.4	.50%
Surface Sensors	WIVIS SCAN	15.00	25248.0	10%
NovaLynx	6070-A	2.10	4688.4	N/A

3.1.6.2.9 Precipitation Type

Two sensors/systems in this study measure precipitation type. The accuracies of these sensors are not available. However, due to the limited number of these types of sensors all are being considered in this study.

Reference 3.1.1.31, Precipitation type

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Surface Sensors	WIVIS SCAN	15.00	25248.0	N/A
Scientific Sales	301	27.00	132.7	N/A

3.1.6.2.10 Pressure Altitude

Paroscientific offers three different sensor series with the highest accuracies listed for this requirement. These small devices require an interface with a computer for information display.

Reference 3.1.1.32, Pressure altitude (m)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Paroscientific	9000 Series	.40	215.5	.01%
Paroscientific	6000 Series	.43	277.0	.01%
Paroscientific	1000 Series	.82	796.6	.01%

3.1.6.2.11 Seeability: Ultraviolet

One sensor, the NovaLynx 3321, found in this study measures ultraviolet emittance. The 3321 uses a pair of CdS photocells to make this measurement. The sensor provides up to 100 hours of continuous operation.

Reference 3.1.1.35, Seeability: Ultraviolet (%)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
NovaLynx	3321	.27	340.7	N/A

3.1.6.2.12 Solar Radiation

Seventeen different sensors were evaluated for this requirement. The LI190SB accurately measures photon flux density in natural and artificial light. The measurement is taken with a silicon photovoltaic detector. Measurements are converted and measured directly by a data logger.

Reference 3.1.1.37, Solar radiation

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Campbell Scientific	LI-190SB	.03	11.5	N/S
Climatronics	100553	.45	393.0	N/S
Qualimetrics	3020	.86	1806.9	N/S

3.1.6.2.13 Temperature

Sixty-nine temperature sensors for surface air, air profile, upper air, dewpoint and chill index are listed in Appendix B. Several of the sensors do not have stated accuracies. Because of the large number of manufacturers under this category sensors with stated accuracies are the sensors considered first. The temperature sensors are available for use in air, water and soil. A diagram of a dewpoint sensor is shown in Figure 3.1.6.2.13-1. The breakdown of the top three (where

possible) candidates for each requirement and their weight, volume and accuracies are listed below.

Reference 3.1.1.40, Temperature, air, surface (C)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
AIR	CT-1A-T	.45	420.0	.05%
Scientific Sales	4470-A	.10	11.9	.10%
Scientific Sales	5129 D/E	.23	61.2	.10%

Reference 3.1.1.41, Temperature, air, profile (C)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
REMTECH	RASS	N/A	N/A	0.2 C
Radian	LAP-3000a	N/A	N/A	1.0 C

Reference 3.1.1.42, Temperature, air, upper (C)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
AIR	IS-4A	.22	N/A	.50 C

Reference 3.1.1.43, Temperature, dewpoint (C)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Climatronics	101197	N/A	6.2	1.00 C
Climatronics	EWS	20.0	44926.2	1.00 C

Reference 3.1.1.45, Temperature, EQ chill index (C)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Davis	WeatherMonII	.50	1525.9	2.0 C
Davis	WeatherWizIII	.50	1525.9	2.0 C

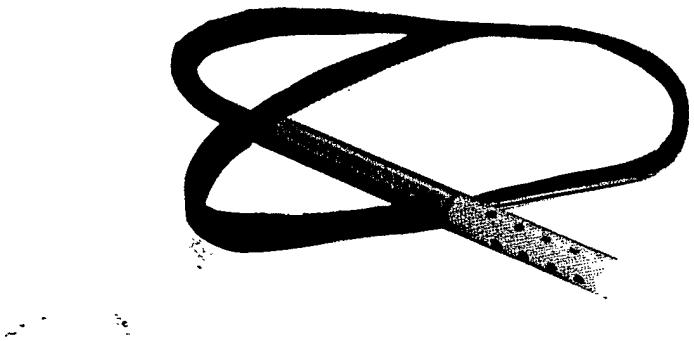


Figure 3.1.3.2.13-1 Dew Point Sensor

3.1.6.2.14 Optical Turbulence

One sensor, the Scintec SLS 20, found in this study measures the optical turbulence. The SLS 20 measures structure function constant and inner scale by comparing the scintillation of two slightly shifted parallel low-power laser beams. Due to a different polarization each beam is identified at the receiver and separately detected.

Reference 3.1.1.50, Turbulence, optical

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Scintec	SLS 20	2.90	7623.0	N/A

3.1.6.2.15 Visibility

Sensors were investigated for their ability to capture information. Eight sensors provided the desired results. However, not all sensors had accuracy information available. The top sensors vary in size and weight. The tradeoff for weight is duration of unattended data capture. The three best choices are listed below.

Reference 3.1.1.51, Visibility, visible spectrum (%)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Air Resource Spec	Optec NGN-2	68.00	191700.0	10%
Air Resource Spec	Optec LPV-2	7.00	7774.0	N/A
Vaisala	FD 12	20.00	4222310.0	N/A

3.1.6.2.16 Wind

One hundred-seventy-three wind sensors for profile speed and direction, surface speed and direction, upper air, speed and direction, are listed in Appendix B. Several of the sensors do not

have stated accuracies. Because of the large number of manufacturers under this category sensors with stated accuracies are the sensors considered first. Figure 3.1.3.2.16-1 shows one type of wind speed/direction sensor system. Figure 3.1.3.2.16-2 shows a wind profile sensor. The breakdown of the top three (where applicable) candidates for each requirement and their weight, volume and accuracies are listed below.

Reference 3.1.1.52, Wind, profile, speed and direction (m/s, deg)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Applied Tech	MiniRadar	23.00	677222.0	.25 m/s
Remtech	HPPA1	45.00	N/A	.30 m/s
Remtech	PA1	N/A	N/A	.30 m/s
Applied Tech	MiniRadar	23.00	N/A	N/A
Remtech	HPPA1	45.00	N/A	N/A
Radian	LAP-3000a	N/A	N/A	N/A

Reference 3.1.1.54, Wind, surface, speed and direction (m/s, deg)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Vaisala	WAA 15A	.50	1394.1	.01 m/s
Applied Tech	V Style	.45	5639.8	.05 m/s
Applied Tech	K and Sx Style	1.00	36712.1	.05 m/s
Applied Tech	V Style	.45	5639.8	.10 deg
Applied Tech	K and Sx Style	1.00	36712.1	.10 deg
EASI	EZ160/164	5.00	5301.0	1.00 deg

Reference 3.1.1.57, Wind, upper air, speed and dir (m/s, deg)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
AIR	IS-4A	.22	N/A	N/A m/s
AIR	IS-4A	.22	N/A	N/A deg

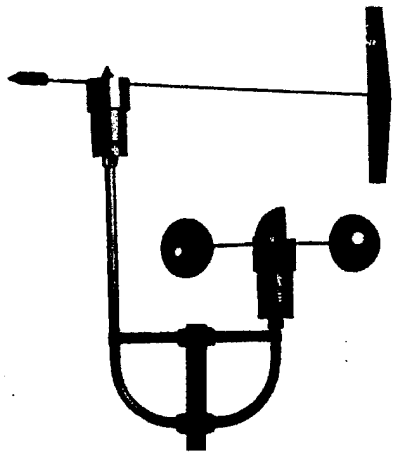


Figure 3.1.6.2.16-1 Wind Speed/Direction Sensor System

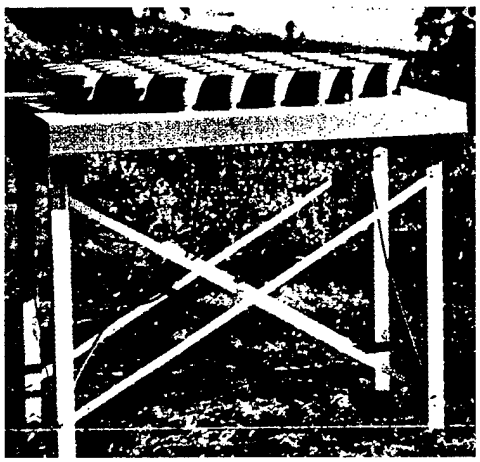


Figure 3.1.6.2.16-2 Wind Profile Sensor

3.1.6.2.17 Water Depth

Fourteen sensors were evaluated for this requirement. Handar offers three different sensor series with the highest accuracies listed for this requirement. These small devices require an interface with a computer for information display.

Reference 3.1.2.01, Water depth

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Handar	451A/B/C	.82	792.6	.01 %
Handar	436A/A-1	1.13	2305.8	.01 ft
Handar	436B	1.13	2305.8	.01 ft

3.1.6.2.18 Water Column Properties

Water column properties sensor requirements include surface temperature, temperature profile, water turbidity/visibility, and water salinity. The accuracy requirements are met in all categories. Sensors range from small hand-held devices to large weather systems. The weather systems are discussed in the next section. The list of sensors meeting METOC requirements are as follows.

Reference 3.1.3.01, Surface temperature (C)

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Metocean	CMOD	12.73	10684.6	.16 C
Scientific Sales	4486	.10	0.2	.30 C
Metocean	WOCE Drifter	.45	227.0	1.00 C

Reference 3.1.3.02, Temperature profile

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Sippican	XCTD	2.50	4527.4	.03 C
Sippican	SSXBT	2.50	4527.4	.15 C
Sippican	XBT	2.50	4527.4	.15 C

Reference 3.1.3.03, Water turbidity/visibility

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
LI-COR	LI-193SA	.14	85.0	N/A
LI-COR	LI-192SA	.23	36.7	N/A
NovaLynx	210-500	.45	115.9	2%

Reference 3.1.3.04, Temperature, water, inland

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Climatronics	100093-2	N/A	3.7	.10 C
Climatronics	100826	N/A	4.9	.10 C
Climatronics	100093	N/A	3.7	.15 C

Reference 3.1.3.08, Water salinity

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Handar	460C	3.36	2874.2	.20 ppt
Hydrolab	H2O	3.36	2874.2	.20 ppt
Endeco/YSO	YSI 6000	2.20	470.0	2.00%

3.1.6.2.19 Ocean Dynamics

Of the requirements listed under Ocean Dynamics, one, current speed, is satisfied by the sensors surveyed. Qualimetrics' 6660 Digital Water Current Meter is a propeller driven photo-optical system which measures water velocity. The unit comes with a 10-pound sinker and up to 50 feet of suspension cable. This lightweight system is portable and easily handled by one person. The top three candidates for current speed sensors and their weight, volume and accuracies are listed below.

Reference 3.1.4.02, Current speed, near shore/littoral

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Qualimetrics	6660	9.00	2069.8	N/A
NovaLynx	Global Flow	0.90	155.3	0.03 m/s
Swoffer	2100	0.60	790.7	1.00%

3.1.6.2.20 Ice/Snow Depth

The Campbell Scientific sensor, UDG01, measures ice/snow depth. The UDG01 acoustically measures the depth of ice or snow. The sensor measures the elapsed time between emission, reflection and return of an ultrasonic pulse. An air temperature measurement is used to correct for variations in the speed of sound. The manufacturer makes the qualification regarding measurements taken during active snowfall in that the snowfall or driving winds may interfere with measurement accuracy.

Reference 3.2.1.03, Ice/Snow depth

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Campbell Scient	UDG01	0.90	962.6	1.00 cm
Metocean	Ice Platform	250.0	1308751.3	N/A

3.3.6.21 Ground State Conditions

Sensors were investigated to determine their ability to measure ground moisture and temperature to aid, among other things, in determining the trafficability of an area. NovaLynx, Climatronics and Vaisala offer sensors that meet METOC requirements. The sensors are compact and lightweight. The NovaLynx moisture sensor is solid state electrical resistance type sensor. The sensor is compatible with data loggers and telemetry type systems. For the telemetry system data is transmitted via infrared, radio, or telephone to a computer-controlled base station. The Vaisala ground temperature sensor is designed for use with automatic weather stations. The Vaisala sensor can be used for road ice prediction, giving a 24-hour road surface prediction forecast.

Reference 3.2.1.07, Soil/Ground moisture

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
NovaLynx	250-110	0.22	19.4	N/A
Climatronics	100093-2	N/A	3.7	.10 C
Climatronics	100826	N/A	4.9	.10 C

Reference 3.2.1.08, Soil/Ground temperature

MANUFACTURER	MODEL	WT(kg)	VOL(cm3)	ACCURACY
Vaisala	DTS 12G	0.17	3.7	.08 C
Climatronics	100093-2	N/A	3.7	.10 C
Climatronics	100826	N/A	4.9	.10 C

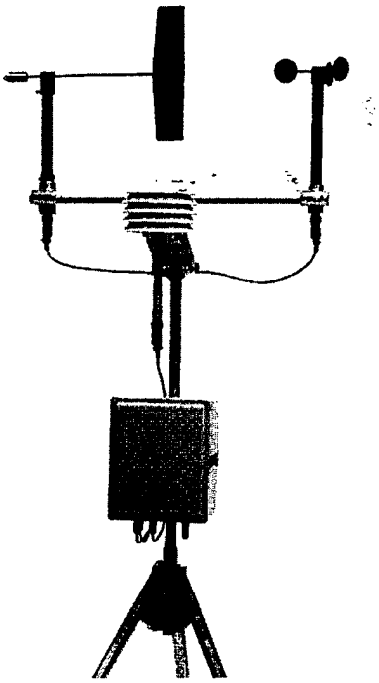
3.1.7 Weather Systems

Several weather stations were investigated in this study as well. Many of the systems perform multiple measurements are lightweight and portable. Data is linked directly to a computer in many instances but also may be transmitted remotely in some instances. A full listing of the weather systems reviewed in this study is located in Appendix C of this document.

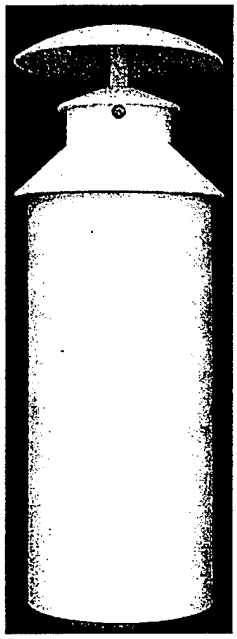
3.1.7.1 Commercial Meteorological Systems

Below are figures of some commercial weather systems included in this study. In addition, a table follows noting the sensors available for each weather system. Costs indicated are merely

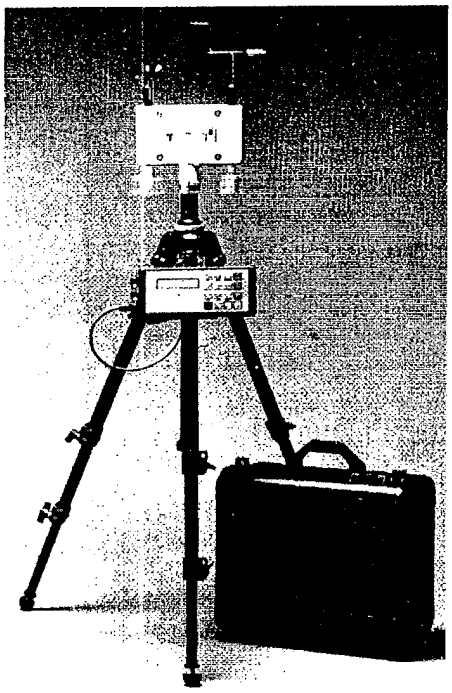
estimates and do not include the price of cables, data loggers, computers or other readout devices which may be required for weather station output.



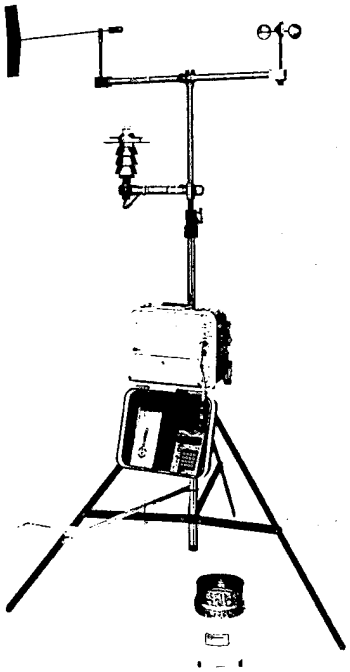
AUTOMET



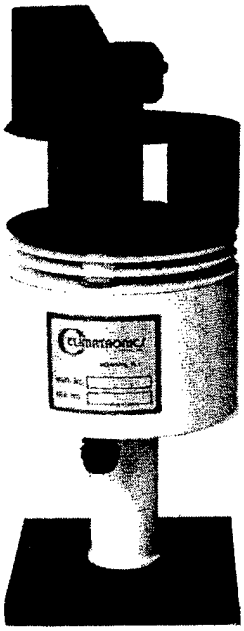
TFV4056



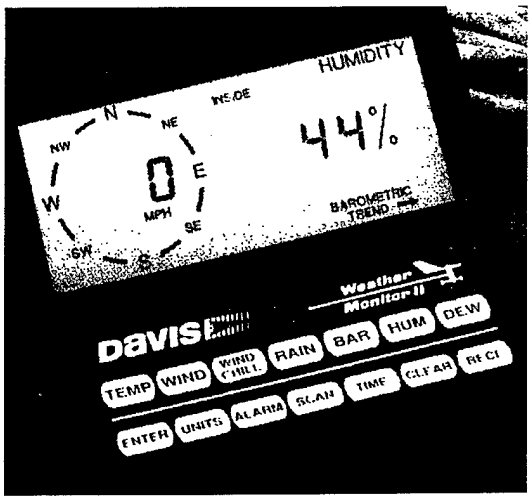
TAMS



MICRO EWS



TACMET



WEATHER WIZARD III

3.1.7.2 Improved Remotely Monitored Battlefield Sensor System (IREMBASS)

The IREMBASS is a light weight, multisensor (magnetic, seismic, acoustic and infrared) data collection system in use by the Special Operations Forces consisting of sensors, ground based radio relays, and monitors. It can be emplaced and remain unattended along avenues of approach or intrusion for periods up to 30 days, allowing SOF to monitor activity from a safe location. It is basically considered an intel system capable of detecting and classifying types and numbers of vehicles and personnel. A Product Improvement ECP has also been submitted for these units to incorporate the ruggedized Climatronics meteorology package. The Climatronics addition is the TACMET system shown in the tables and figures. One of the unique coincidences that results from this addition is the possibility that the IREMBASS with a meteorological package could take advantage of the IREMBASS communication frequencies which operate in the 137.5 MHZ range; the same range as the ORBCOMM satellite communications system and the polar orbiting weather satellites. This is discussed in more detail in the communications section of this report. (Section 3.2.5)

3.1.8 Miniaturized Sensor Developments

The SBIR team requested and received information concerning the Naval Research Laboratory conference on "Sensors for Characterizing the Hinterland," This conference occurred on April 26, 1994. The information was received in September. The late arrival of this information, in the research process did not allow for it to be included in the study. The existence of the information is acknowledged and several notes from it are included.

It is noted that there is a critical deficiency in the Air Force's ability to acquire weather data in uncontrolled and enemy controlled battle areas. This knowledge of the weather is critical for optimal selection of electro-optical weapons to use against a target and for planning strike flight profiles.

There also exists a critical need to be able to sense the littoral environment where access is often denied to forces in the field. Small sized weather stations would be ideal for this purpose. They should have several microsensors, a low power transmitter, a GPS receiver, a processor subsystem, and a self-contained power supply. The size of one of these should be less than 15 cm (8 in) in the longest dimension, in order to reduce the probability of detection. It should be ruggedized and have a volume and weight of less than 200 cubic cm and 400 grams,(0.4 kg) including the battery.

The basic station would collect the following meteorological data:

Parameter	Range	Accuracy
barometric pressure	600 to 1054 mb	±1.0 mb
air temperature	-50 to +35 C	0.2 C
wind direction	0 to 360	15
wind speed	0 to 63 m/s	1.0 m/s
relative humidity	20 to 100%	1 to 5%

A buoy version of this station could also sense additional parameters such as water temperature, ambient noise, and directional wave spectra, while the land-based station could contain a seismometer.

At present, the Jet Propulsion Laboratory (JPL) is in the process of developing meteorological and other microsensors for use in a micro weather station to be placed aboard the Mars Environmental Surveyor.

There is information included on vibrating cylinder pressure transducers from Weston Aerospace, a part of the Solartron Group. The pressure transducers have a high accuracy of 0.01% FSP over a temperature range of -55 to +125 degrees Celsius. It has a balanced resonator system and is insensitive to shock and vibration. It also has a low temperature hysteresis and excellent long term stability.

There is also information on the 'Smart' Pressure Sensors, 7885 series, from Weston. These have been developed for Meteorological applications. They feature a compact enclosure, 100ms update rate, and 0.01% FSP accuracy over a temperature range of -40 to +70 degrees Celsius.

Information was included on ways to develop ocean sensing capabilities that are low cost, real time, and have quick response capabilities with date telemetry for shallow water.

3.1.9 Oceanographic Sensors

Sensors in this category are located on and under the ocean surface and measure ocean conditions below and atmospheric conditions immediately above it. While measurements below the ocean surface are outside the scope of this SBIR, these sensors do include surface weather information required by SOCOM for mission planning and support and are therefore included.

3.1.9.1 Combat Meteorological and Oceanographic Drifter (CMOD) [3]

The Naval Research Laboratory's (NRL) Tactical Oceanographic Warfare Support (TOWS) program is developing a series of expendable sonobuoy shaped sensor packages designated as the AN/WSQ-6 capable of deployment by P3 patrol aircraft. These buoys will be capable of measuring and reporting air temperature (AT), sea surface temperature (SST), barometric pressure (BP), subsurface ocean temperature versus depth (TZ) at various intervals down to 600 meters, omnidirectional ambient noise (AN), wind speed and direction (WS/WD), and directional wave spectra. Data are sampled hourly and transmitted in Service Argos formats via NOAA polar orbiting (TIROS) satellites. These units have been used operationally for three years.

A US/Canadian Development Sharing Agreement is developing four more configurations, and an option for a fifth, of the basic AN/WSQ-6 series:

XAN-1 is similar to the CMOD and includes the acoustic sensor.
XAN-2 (CMOD/ANS) calls for the addition of a broadband hydrophone at 100 meters depth to collect omni-directional ambient noise at 16 frequencies between 5 Hz and 25 kHz.
XAN-3 (CMOD/TZ 300 meter) calls for a 300 meter thermistor string below the bouy to measure temperature at depths corresponding to the Navy's Optimum Thermal Interpretation Scheme (OTIS) seawater model.
XAN-4 (CMOD/TZ/ANS) calls for combining the thermistor string, the hydrophone, and a command receiver for buoy scuttling.
XAN-5 (CMOD/WS/WD) calls for the incorporation of expendable wind speed and direction sensors (considered to be the most crucial development).

An additional development is underway to add directional wave spectra capabilities to a CMOD type bouy.

The Navy is also supporting a NASA initiative to add a multi-channel passive upwelling optical radiance filter attached to a prototype (CMOD) buoy. This bouy is to be deployed in conjunction with the SeaWiFS ocean color monitoring satellite. Plans are to make an optical chain with several radiance or irradiance sensors at various depths using the thermistor chain technology on a similar optical buoy design.

3.1.9.2 Tropical Ocean and Global Atmosphere (TOGA) Drifting Buoys [4]

In support of the international TOGA program NOAA contracted with PRL (now Defense Systems Inc.) in 1978 to produce a series of drifting buoys

3.1.10 Sensor Recommendations

Many of the surface sensors and weather systems investigated for this study satisfy the METOC requirements set forth by USSOCOM. While some of the small, lightweight sensors are ideally suited for remote areas, the larger, more durable weather systems also have real application at the Force and above levels.

With the data gathered from this phase of the study we recommend a meeting to discuss the next phase. A determination as to the users of the sensor information is necessary to define system size requirements and data information requirements. A system can be integrated for Force components, where data type is important not so much the system size and power requirements. Further, a system can be integrated for the unit level where size and power requirements are more of a driving factor.

Once the Phase II user has been determined we can set forth looking at the combination of sensors and systems which will most efficiently and economically meet user requirements.

One approach is to look at individual sensors and build a modular weather station that will meet the specific needs of the user. This approach is not highly recommended in that integrating individual sensors into one unique weather system can be bulky, costly and, most likely, unnecessary.

A second approach is to look at full-up, commercial weather systems which will satisfy most of the user requirements. Although this is a more economical route, it will probably leave important requirements unmet.

The third and recommended approach is to investigate which weather systems will satisfy the majority of user requirements. With those systems, further look at the feasibility of integrating additional sensors into the system to meet unique requirements. Every effort will be made to make the sensor suite as accurate, lightweight, reliable and complete as possible. Additionally, the suite will be modularized. The study needs to ensure an additional array of sensors may be integrated into the system to easily adapt to additional users, their requirements and changing environments.

3.2 Communications Systems

Adequate communications is an essential component for improved METOC support to joint special operations forces. The communications equipment capabilities must include joint connectivity and operability between the various services, and must provide the ability to communicate and process the data required by METOC units deployed in the field in a timely manner. The communications support to the SOCRATES METOC srchitecture is focused at getting meteorological information from higher levels of command and information support

centers to the JSOTF or theater level. One of the major assumptions of this SBIR was that the communications necessary to provide global products to a theater will be available. This assumption was addressed in meetings with the AFSOC weather branch chief. Improvements to the sensing architecture and extending meteorological data to weather users requires additional communications that cannot be accommodated by the systems providing current communications for meteorological support in a theater. The existing METOC communications systems are described in the following section.

Enhancements to these existing communications systems were considered as part of this SBIR. As with the sensing systems, the constraints on the communications solutions included the size, weight and power consumption of the system. The ability to produce very small sensors or use laptop computers as weather effects display devices is of little value if the communications device required to implement such a system is significantly larger.

The communications systems evaluated for this SBIR can be separated into two distinct categories; those that are inherent elements of weather systems (e.g. direct downlinks from weather satellites) and pure communications systems (e.g. SLDCOM or ORBCOMM). Inherent weather communications systems offer significant advantages in that their use does not conflict with other priority communications. These advantages are primarily oriented toward the first customer group, the meteorological staffs, but could also be exploited by deployed forces. Figure 3.2-1 shows the general breakout of the types of communications systems evaluated during this SBIR.

Meteorological Communication Systems	**General Communications Systems**
- Polar Satellite Downlink TIROS/DMSP - Geostationary Rebroadcast GOES/GMS/METEOSAT - Metsat Data Collection System GOES Data Collection Syst ARGOS (TIROS) - Surface Sensor Links IREMBASS	SLDCOM ORBCOMM IRIDIUM INMARSAT

Figure 3.2-1 Communications Systems Applied to this SBIR

3.2.1 Current METOC Communications

Present capabilities for most METOC SOF units is heavily dependent upon Goldwing (USA and USN) and QRCT (USAF) systems. HF system bandwidths support only voice and alphanumeric data transfers at low data rates. These systems and the USMCs Goldwing compatible system cannot communicate with the UAWS systems (USA Europe) and none can receive the Navy Fleet Broadcast HF Mode due to incompatible encryption devices.

Standard networks for distribution of SOF METOC products currently used include SOFTACS, SOCRATES, and the DSCS, FLTSATCOM, MILSTAR and UHF follow-on SATCOM systems. These systems get data into a theater or other fixed locations but are unable to get data from small environment sensors in the AOR to the SOF tactical users. For example:

- The Automated Weather Network (AWN) is available only to fixed sites world-wide, and is not available to mobile forces immediately upon deployment.
- AUTODIN is reliable, but too slow for the perishable METOC information. It is usually the NAVY's only connectivity to the Joint METOC Forecast Unit (JMFU) and is not available to mobile ground forces.
- The Fleet Multi-Channel Broadcast (FMCB) is an encrypted UHF-SATCOM "receive only" capability currently used only by the Navy and Marine Corps. The Army and Air Force do not have the necessary equipment (encrytion and receivers). FMCB is slow (75 baud) and the improved capability (9600 baud) will not be available until 1996.
- The Navy Oceanographic Data Dissemination System (NODDS) is an interactive computer dial-in system for Gridded Data Field Products. It requires a telephone link with the Fleet Numerical Oceanography Center, which is virtually never available to mobile land forces.
- The INMARSAT worldwide, commercial satellite telephone system can be used by mobile forces to exchange METOC information, but the small, lightweight satellite terminal leasing and usage rates are very expensive.
- No high resolution METSAT imagery exchange capabilities exist within the AOR. Usually the Air Force receives direct METSAT Imagery at only one central location in the AOR. Scanning and retransmission of imagery over tactical circuits causes degraded quality and resolution. The capability to receive high resolution imagery and data from meteorological satellites is planned as modules III and IV of the SOCRATES METOC architecture.
- The Navy is using SHF satellite communications to provide gridded data fields to the Tactical Environmental Support System (TESS) on an interim basis until the High-Speed Fleet Broadcast (HSFB) system comes on line. It is a Fleet CINC asset, with CINC set priorities, it is slow (300-1200 baud), used only by the Navy, and no other Service component METOC organizations have the proper equipment to receive the SHF satellite broadcasts.

Advanced experiments in transmitting meteorological products over other communications assets have been conducted over the past year. A short synopsis of these experiments is provided below. These experiments enhance the delivery of global products to theater level but do not appear to provide a useful means of providing intra-theater communications.

Graphics and high resolution color imagery data require extraordinary amounts of time to transfer via the narrow band systems unless data compression techniques such as the Joint Photographic Experts Group (JPEG) Image Compression techniques (see MIL-STD-188-189) used for the National Imagery Transmission Format (NITF) is used. Using these data compression techniques, high resolution imagery can be transmitted in image segments using single files of approximately 40 Kilobits in length, and at data rates from 9.6 to 64 Kbps. In this manner, after data decompression at the receiving end, relatively large digital color images can be transferred in reasonable times without loss of resolution. The M22 Weather Data Relay Experiment was tentatively scheduled to perform this function on 21 July 94 and 25 January 95. The purpose of these experiments was to validate the feasibility of transmitting weather data (of undisclosed nature) from the Automated Weather Network (AWN) to the MTOC at Onizuka AFB, CA. using the M22 system. The receive equipment to be used is the CHARIOT and SOF / IRIS. Requests for support and/or other equipment approval is by coordination with HQ Air Weather Service/Special Projects. In mid-1995 a weather information in the cockpit exercise is planned that will provide weather products to aircraft enroute to targets. While these exercises do not provide the kinds of capabilities required to improve the sensor architecture they do indicate the desire of weather users (the second customer group) to receive weather information beyond the last weather briefing received prior to mission departure.

3.2.2 Communications Overview

Terrestrial analog radio communications systems have been used for most of the 20th century at frequencies below 30 MHz. The early terrestrial systems were severely limited to short transmission distances or communications unreliability, large antenna size, narrow information bandwiths, and high primary power consumption. The high technology digital information explosion of the last few years, coupled with space technology has created new horizons in the information communications field.

Point-to-point information communication is classically defined in terms of the information (in bits) transferred from the source to the destination per unit time with less than a given number of bit errors. Information communications is therefore measured in "bits per second" transferred at less than an allowable "bit errors per second" error rate. The bit error rate can vary over a wide range as a function of many technical variables but for reliable communications is generally assumed to be .00001 bit per second, including all noise sources (thermal noise, man-made noise, and others). Various combinations of system parameters including bandwidth and data compression (coding) techniques, M-ary digital modulation, spread spectrum and carrier

suppression techniques can be used to improve digital communication efficiency, provide desirable transmission characteristics and reduce the information bandwidth required for particular applications.

Communications Satellite relay systems such as those discussed here-in and currently in use by all of the major Television networks have overcome the shortcomings of terrestrial systems. Although LOS in nature, the imposition of an orbiting satellite relay (either low altitude or geosynchronous) allows ground stations approaching the earth's diameter apart to reliably communicate without suffering the attendant problems associated with terrestrial systems. In fact, a satellite relay system can provide signal gain via amplifiers in the satellite while maintaining the wide bandwidths required by television and imagery video signals. Communications satellites, therefore represents the most cost effective means of obtaining long distance wide-band communications for meeting the USSOCOM forces requirements.

3.2.3 Data Types to be Communicated

The types of data that are required to support the two customer groups identified in this SBIR include:

- Satellite imagery and special sensor data
- Surface and airborne sensor data
- Gridded data fields from global meteorological centers

3.2.4 Meteorological Communication Systems

This section discusses those communications systems that are currently available as inherent elements of meteorological systems. As discussed in the section introduction, these communications systems offer the advantage of nearly unrestricted use. Each communication system is described in detail, after which the application advantages and disadvantages of each system to the SBIR Passive Remote Sensing system are discussed.

3.2.4.1 Satellite Direct Downlink/Broadcast Capabilities

Direct downlinks of satellite imagery at the JSOTF level will be a principal source of broad area meteorological data to support the SOCRATES METOC architecture and the enhancements proposed in this SBIR. This requirement for direct satellite links is recognized by the SOCOM meteorological staffs and is included as part of Module I, III and IV of the SOCRATES METOC architecture. Because retransmitting imagery can take a considerable amount of communication bandwidth, it is desirable to obtain this type of imagery via direct downlinks. Raw weather

satellite imagery requires some expertise to analyze. While the SBIR approach is generally to push meteorological information out to deployed forces that may not have meteorological support, direct downlink of satellite imagery is presumed to stop at the last meteorological staff level. In the case of SOCOM, that level is most likely the JSOTF.

The fielding of the Man Transportable SOCRATES/IRIS (MTS) will provide the SOCOM with capability to exploit real-time multispectral imagery from GOES and DMSP satellites. Minor modifications or add-ons to the IRIS system would also provide real-time imagery capability from the US TIROS polar orbiters and other countries' geostationary environmental satellites. Although the TIROS and DMSP data are transmitted at different frequencies and DMSP data is currently encrypted, these two systems are targeted for merger (early 2000s) with the resulting constellation consisting of three operational satellites. The details of this merger are not currently available, but provisions for jointly interoperable data decryption, used or not, should be incorporated in the JOINT SOCOM ground data processing facilities.

3.2.4.1.1 TIROS Imagery.

HRPT data are transmitted at full resolution (1.1 km), and the APT resolution is reduced to keep the transmitted signal within the allowable transmission bandwidth (2.4 KHz). The HRPT data is transmitted at a data rate of 665.4 KBPS with lower data rate instrumentation output data multiplexed between major and minor frames of the AVHRR video data. The TIROS Information Processor (TIP) includes the following types of data at the indicated data rates:

HIRS/2 (High Resolution Infrared Radiation Sounder /model 2) at 2880 BPS
SSU (Stratospheric Sounding Unit-British) at 480 BPS
MSU (50 GHz Microwave Sounding Unit) at 320 BPS
DCLS (Data Collection and Location System-French) at 720 BPS

3.2.4.1.2 DMSP Satellite Imagery and Data

Defense Meteorological Satellite Program satellites are equipped with sensors that perform visible, infrared and microwave imaging, microwave sounding and space environmental sensing. DMSP satellites, like their civil counterpart TIROS, broadcast two real-time signals. Real time data (RTD) is the 1.024 Mbs real-time broadcast of high resolution imagery, soundings and microwave imagery. Real time data smoothed (RTDS) is the 66Kbs broadcast of a lower resolution imagery product that will also include the microwave imagery and soundings. RTDS was implemented on the DMSP satellite launched just prior to Desert Storm. These broadcasts are roughly analogous to the HRPT and APT broadcasts from TIROS. RTD and RDS data is transmitted at 2267.5, 2207.5, 2252.5, and 2237.5 MHz at 1024 and 66 KBPS. It requires a gimbaled high gain tracking antenna and a KG 44 decryptor to receive the down link data.

3.2.4.1.3 Geostationary Operational Environmental Satellite (GOES) Imagery

GOES simultaneous VISSR/WEFAX low resolution imagery data are transmitted by both GOES East and GOES West every 30 minutes and are available from the WWB or in a "stretched VISSR" low data rate version directly from the satellite. Stretched VISSR imagery will no longer be available when GOES 9 replaces GOES 7 which is currently scheduled to occur in April 1995. At that time GVAR, a variable frame rate sectorized imagery service will be available as a direct broadcast. Receivers for GVAR imagery will be available, but require a 12 ft dish and are software intensive.

Low resolution imagery of most of the Western Hemisphere is available in near real-time directly from the GOES WEFAX, Stretched VISSR, and soon the GVAR system at 1687.5 MHz down link from the GOES satellites.

3.2.4.1.4 Geostationary Meteorological Satellite (GMS) Imagery

Japan operates one geostationary satellite, GMS, which has a satellite subpoint at 140 degrees East Longitude. Its coverage area is from the south pacific to Siberia and from Hawaii to India. Limited amounts of GMS imagery is available to GOES TAP customers and is transmitted in WEFAX format (240 LPM). For further information contact the nearest NESDIS SFSS.

3.2.4.1.5 European Geostationary Meteorological Satellite (METEOSAT) Imagery

The European Space Agency operates a geostationary satellite, METEOSAT, which has a satellite subpoint on the Greenwich Meridian (0 degrees Longitude). Its coverage is from the south Atlantic to Greenland and from Saudi Arabia to Brazil. It offers visible, infrared, and moisture channel data. Limited amounts of METEOSAT data, in WEFAX format (240 LPM), are available to GOES-TAP customers. For further information contact the nearest NESDIS SFSS.

3.2.5 Satellite METOC Data Collection Systems

3.2.5.1 GOES Data Collection System.

The GOES Data Collection System (DCS) has been established for collecting environmental data from almost any location in the Western Hemisphere. The DCS has been sized to provide approximately 10,000 messages per hour per spacecraft utilizing more than 100 separate data channels on each spacecraft. The Data Collection Platform (DCP) is designed to accept data from a wide variety of sensors. There are three types of DCPs; self-timed, random reporting, and

interrogated. The user's data requirements determine the type of DCP. The GOES satellite serves as a communications relay device between the remotely located DCPs and the Command and Data Acquisition (CDA) ground station at Wallops, Virginia. These data are relayed from the CDA by conventional communications means to the GOES DCS control center at the World Weather Building (WWB) near Washington, D.C. Users may obtain the data from the WWB by telephone at various data rates or receive the data directly from the satellite The GOES DCS has been specially designed to accommodate environmental emergency programs; flash floods, seismic and tsunami events, and hurricane activity as well as more routine but significant environmental information. The GOES DCS also has the capability of working with a spare satellite located midway between the west and east operation satellites in the event that a major failure occurs on one or both of the primary satellites or during eclipse periods. Organizations that plan to collect data utilizing GOES DCS must forward a request to NESDIS for participation. The request and approval by NESDIS would establish that organization as a user.

Advantages of GOES DCS utilization by SOCOM for METOC data are:

1) It would further the government's program for dual use technology
2) SOCOMs Portable Field Stations could have reserved METOC data channels including encryption devices (if required) and these platforms could be deployed and used, anywhere between the Eastern Atlantic Ocean, throughout the Western Hemisphere to the Western Pacific Ocean on a 24 hours per day basis.
3) Data from any of the thousands of existing government owned METOC reporting stations could also be used by SOCOM by obtaining proper permissions from the government owners.

Disadvantages of SOCOM's use of the GOES DCS are:

1) Utilization is limited to the Western Hemisphere.
2) Directly transmitted weather data (encripted if required) would be available to anyone with the proper receiving equipment.

3.2.5.2 ARGOS Data Collection and Location System (DCLS).

The ARGOS Data Collection and Location System (DCLS) was designed, built and furnished by the Centre National D'Etudes Spatiales (CNES) of France with help from NASA and NOAA for the TIROS-N and ATS series of polar orbiting satellites. ARGOS is operated by North American Collection and Location by Satellite, Inc. (NACLS) of Landover, Maryland in accordance with a 1986 Memorandum of Understanding between NOAA and CNES. It provides a means for locating the position of fixed or moving Platform Transmitter Terminals (PTTs) and for obtaining telemetered sensor data from them. The TIROS satellite payload is currently

operational on NOAA 9, 11, and 12 polar orbiters, and is planned for use on NOAA-K (to be launched in 1994), L, M, and N. which should therefore make it available for use well into the next century.

The ARGOS System is dedicated to global environmental monitoring and has contributed to world climate change studies, oceanographic research, collection of off-shore weather data, fishing fleet tracking, hazardous material transportation, tracking marine animals and polar bears and recently include oil spill tracking and pollution monitoring.

NOAA maintains two polar orbiting satellites equipped with the ARGOS payload in active operation at all times (and two in backup mode). The following table indicates the approximate number of passes per day of the two active satellites as a function of PTT latitude:

Platform Latitude	Minimum Passes/day	Mean Passes/day	Maximum Passes/day
0 degrees	6	7	8
+/-15 degrees	8	8	9
+/-30 degrees	8	9	12
+/-45 degrees	10	11	12
+/-55 degrees	16	16	18
+/-65 degrees	21	22	23
+/-75 degrees	28	28	28
+/-90 degrees	28	28	28

At each instant, each satellite sees all PTTs within a 5000 KM diameter circle centered on the satellite subpoint. PTTs transmit their messages on the UHF up link frequency of 401.65 MHz. They transmit their messages at preset intervals without interrogation by the satellite. Each message contains up to 256 bits of sensor data and takes a maximum of 920 milliseconds to transmit. Each transmission is followed by an up link "time-out" or repetition period of between 90 and 200 seconds depending on the application while the satellite receives other PTTs. Traditionally PTTs have transmitted the same message 4 or 5 times repetitively during the 10 to 14 minute satellite pass, limiting the user to 32 bytes of data per pass. Since ARGOS location information is not dependent upon the telemetry data content, different data can be sent on each transmission, thereby increasing the usable data to 256 bytes per pass. When several messages are received during a given pass from a given platform, the platform location can be determined using differential Doppler techniques. The DCLS payload receives the PTT transmitted UHF carrier and data which is then retransmitted in real time over the VHF (136.77/137.77 MHz) Beacon Downlink Transmitter. The data is also multiplexed with the S-Band (1698.0 and 1707.0 MHz) High Resolution real-time video data (HRPT) at 665.4 KBPS and recorded for retransmission to the ground when the satellite passes over the ARGOS Global Processing

Centers located at Wallops Island, Virginia; Fairbanks, Alaska; Lannion, France; a regional processing center in Australia; and soon in Japan. Location information, when processed by the ARGOS Global Processing Centers provides location accuracy to +/- 150 meters with their new software incorporating improved calibration and data reduction algorithms. Other less accurate positions are also available. Telonics Corporation manufactures ARGOS up link transmitters and a system to compute the platform location and environmental data reduction in near real time from the 720 BPS ARGOS DCLS data from the TIROS Information Processor (TIP) . Using the Telonics System the environmental data is reconstructed, but the position data accuracy is degraded to +/- 1 KM. The ARGOS DCLS payload is currently used by approximately 2000 active transmitting platforms world wide, of which 500 to 1000 are Military users (mostly US Navy). Users' platforms vary from drifting buoys, fishing vessels, oceanographic research, wandering animals, to ship movements, and theater operations. Users are located all over the world, but mostly from the US, Canada, United Kingdom, France, and Western Europe. The ARGOS payload is currently used at about 10% of its capacity and is capable of handling many more platforms. The following table shows the increased down-link data rates for the ARGOS payloads which will increase the maximum number of PTTs the spacecraft can handle in its footprint with 32 and 256 bits of data per message:

Satellite NOAA-	Est. Launch	Band-Width (KHz)	Rcvr Sens. (dBm)	Proc. Units	Data Rate (B/Sec)	Max. PTTs @ Message Length in Footprint @ 90 Sec Rep Rate
9, 10	Orbiting	24	-128, -108	4	720	650 @ 32 bits 254 @ 256 bits
11	Orbiting	24	-128, -108	4	960	750 @ 32 bits 293 @ 256 bits
12	Orbiting	24	-128, -108	4	1200	750 @ 32 bits 293 @ 256 bits
K	TBD 95	80	-131, -108	8	2560	2075 @ 32 bits 812 @ 256 bits
L	May 97	80	-131, -108	8	2560	2075 @ 32 bits 812 @ 256 bits
M	June 99	80	-131, -108	8	2560	2075 @ 32 bits 812 @ 256 bits

The US Government has negotiated a Joint Tarriff Agreement with the French which is independent of the number of platforms in use, but on the average, we pay the French approximately $11 per day, per transmitting platform for the privilege of using ARGOS.

The advantage of using the ARGOS system in this application is that the METOC information, including the remote station (PTT) identification, the time of surface sensor measurements and the surface sensor location is received on the same RF carrier (1698.0 MHz) with the High Resolution Imagery Data (HRPT) from the TIROS environmental satellites requiring a single Earth Station receiving system for both Hi - Res video and remote sensor (PTT) data which eliminates the need for coordination between communications satellites and environmental satellites and their ground availabilities. Since the TIROS Imagery and surface sensor data are both transmitted in real-time, delays normally experienced in data distribution by CLS, NESDIS and other non-real-time systems can be avoided by user processing.

METOCEAN has developed a new ARGOS PTT package (MAT906) which incorporates a GPS receiver for location information. This package can be retrofitted to existing PTT platforms and does not require use of the ARGOS differential doppler ground system for determining platform location. Using this package, both sensor data and accurate platform location information can be obtained directly from the satellite.

The disadvantages of using the ARGOS DCLS for METOC data are:

1) Data is only available when the TIROS passes are visible.
2) Cost of use of the ARGOS system is approximately $11 per day per transmitting platform.
3) If the surface sensor data requires encryption, both the encrypted data and platform location would be available to the data processing personnel and anyone else with the proper receiver.

3.2.5.3 IREMBASS communications system.

The IREMBASS sensor data is compiled into short digital messages and communicated by radio burst transmission. The sensor normally communicates with the IREMBASS Monitor/Programmer Set, either directly or through radio repeaters for an extended monitoring distance (15 km per repeater package). Messages at the monitoring set, or an enhanced display capability through a portable computer, are demodulated, decoded, temporarily displayed, and recorded to provide a time-phased record of enemy activity.

The units communicate in the 138 - 154 MHz band using a 19 inch whip antenna and a minimum power output of 2 watts. The data can be sent via the RS-232C monitor-programmer port to the AN/PSQ-7 Advanced Monitoring System Display (AMSD) for graphical display, message time tagging, and logging.

Advantages of using the IREMBASS system for SOCOM support are:

1) While the IREMBASS is normally thought to be a ground-to-ground intel intrusion detection and communications system with repeaters to extend its range beyond 15 km; its sensor payload can be made to include METOC data and its transmission frequency band can be tuned to the ORBCOMM up link frequencies (148-150.05 MHz) discussed in section 6.4.2.3. The ORBCOMM discussion below would therefore apply to the IREMBASS system, extending its operational range with no hardware changes to near global proportions.
2) The system already exists, and development costs would be non-existent.
3) Using it in conjunction with the ORBCOMM system would make the data available world-wide, at all times, without concern for satellite pass availability.

Disadvantages of using the IREMBASS system for SOCOM support are:

1) Without the use of the ORBCOMM system as a data relay, another data relay system must be used, such as the terrestrial repeaters or SLDCOM or other SATCOM system. Use of the terrestrial repeaters will strictly limit the transmission range. Use of LEO satellite data relays will provide less than 100% availability.
2) Use of SLDCOM data relays would provide greater than LEO satellite coverage but less than 100%.
3) Transmitter power is not adequate for synchronous satellite data relay without modification.

3.2.6 General Communications Satellite Systems

This category includes constellations of multiple satellites with complementary orbits, either to optimize coverage in a given area, or to provide world-wide coverage at all times. The satellite communications considered for this SBIR were restricted to those that offered very small transceivers. The upper limit on the size of a satellite communications ground terminal was the INMARSAT system. Reiterating an earlier stated assumption, the delivey of weather products from the global centers to the theater is assumed to take place via the communications systems shown in the SOCRATES METOC architecture (Figure 3.XX). Most of those communications systems are not discussed in this section.

3.2.6.1 Satellite Launch Dispenser Communications (SLDCOM) System

The SLDCOM System, operated by the U.S. Naval Research Laboratory (NRL) is a 3 satellite constellation in near-polar elliptical orbits with apogees favoring the earth's northern latitudes. The System provides extended broadcast communications coverage to high northern latitude

regions beyond the range of geostationary satellites. Two satellites are currently on orbit and operating with a third projected to be launched in January 1995 and operational in the summer of 1995. Most sites in the northern regions can expect 4 passes per day with the current two satellite constellation with the available time per pass up to 110 minutes. With the planned 3 satellite constellation coverage in Fairbanks, Alaska will be extended to 100% of the time with at least one of the three satellites in view at 5 degrees or more above the horizon. The up link military frequencies are 345-355 MHz and the downlink frequencies utilized are 250-258 MHz. The uplink and downlink are independently tuneable over the bands in 10 KHz steps. SLDCOM I has a single channel with selectable bandwidths of 35 KHz, 3 MHz, and 10 MHz. SLDCOM II has two channels with the same characteristics. The planned third satellite (SLDCOM IV) will have a single channel similar to I&II except that the second selectable bandwidth is 150 KHz instead of 3 MHz. Channel 2 of SLDCOM IV can operate in the analog or digital direct relay mode or can include on-board digital processing as required for BPSK, DPSK, QPSK or FSK up to 19.2 KiloShifts Per Second (KSPS). Frequency coverage of SLDCOM IV, channel 2 is also increased, and the tuning steps are decreased to 100 Hz.

The advantages of using the SLDCOM system are:

1) In Northern latitudes, the 3 satellite constellation will provide coverage 100% of the time and at tropical and southern latitudes pass durations are in excess of those achievable with LEO satellites.
2) The system is operated by NRL, which will provide direct support to SOCOM without contractual requirements.

The disadvantages of using the SLDCOM system for SOCOM support are:

1) Usage schedules must be coordinated with NRL who must weigh and allocate useage priorities.
2) 100% coverage is not provided for latitudes below about 60 degrees North.

3.2.6.2 Low Earth Orbit Mobile Satellite Communication (ORBCOMM) System

The ORBCOMM Satellite Communications System is being developed by the Orbital Communications Corporation (ORBCOMM) of Dulles, Virginia, a subsidiary of Orbital Sciences Corporation. It has recently announced that its system coverage has expanded to nearly 50 % of the world's population with the signing of recent international agreements to complete market studies, develop business plans and seek regulatory approvals in preparation for final license agreements beginning later in 1994.

3.2.6.2.1 ORBCOMM System Description

The ORBCOMM digital data communication and position determination system is designed to provide National and Global coverage for two way digital messaging and data communications, light weight, portable subscriber communicators for transportable or fixed use, low cost subscriber equipment and usage charges, and connectivity to most other communications systems. The initial two-satellite system provides delivery of messages and data within hours; and the system will quickly evolve to one providing near real-time transmission of messages. Initial intermittent service is scheduled to begin in the first quarter of 1995, and near continuous service in early 1996.

It can provide the US Armed Forces with two-way on-the-move data messaging anywhere in the world. It will eventually utilize a constellation of 36 small spacecraft in low-Earth orbit (LEO) to provide worldwide geographic coverage. The Subscriber Communicators (user terminals) are inexpensive ($100 to $400 retail), light weight and pocket sized. They transmit and receive short digital burst packets, with the inherent Low Probability of Intercept and Detection (LPI/LPD). The end-to-end time for transmission and receipt of a message is of the order of 3 seconds. The user will be able to compose, transmit and receive messages on very small hand-held devices or devices integrated with palmtop or other computers anywhere in the world. The user need only connect to his antenna (or use an existing vehicle VHF whip antenna) and push the transmit button. With a constellation of 36 LEO satellites (2 in polar orbit) and the system's terrestrial facilities, including any military network or gateway the user will have a satellite in view above 5 degrees elevation continuously over 95% of the time and will have to wait less than two minutes the rest of the time. The use of the ORBCOMM System by the US Armed Forces would be in accordance with the "dual-use" policy (use of commercial assets by the military) supported by the DoD. US Armed Forces can utilize the unique communication capabilities of the ORBCOMM System and use encryption if required.

The ORBCOMM System uses 137-138 MHz for downlink transmissions to the SCs and 148-150.05 MHz up link transmissions to the satellites. A message transmitted from an SC and received at the satellite is then relayed down to the appropriate, as determined by the Network Control Center (NCC), to a regional Gateway Earth Station (GES), four of which are being built in the four corners of the USA. The New York GES is now operational, Arizona is nearing completion, and Washington and Georgia facilities are under construction. The NCC Hardware and Software has been installed in the Washington DC area.

The operating frequencies were approved for use by LEO satellites in 1993. The FCC also granted ORBCOMM an experimental license in March 1992 to launch and operate the first two experimental satellites and up to 1,000 ORBCOMM SCs. The 2 experimental satellites measuring noise in the extended frequency bands in the amended final application. ORBCOMM

subsequently received authority from the FCC to begin construction of the full constellation of satellites and ground facilities. The final FCC license for the total network of up to 36 LEO satellites was issued on October 20, 1994. The first two operational satellites will be launched in the fall of 1994 with 24 more satellites to be launched and put in service by late 1995. As of this writing, the functions and capabilities specific to US Armed forces are expected to be evaluated (Beta Tested) starting in January 1995. Intermittent service with the ORBCOMM System will be available on that date. The complete constellation is expected to be in service by the end of 1995 with service in the United States. Standard addressing is in accordance with international message handling standard X.400 consistent with the 'open system' philosophy, although other specialized options are available. Cost of single user commercial service in the US is estimated at $35 activation fee plus $20 per month service fee plus $0.01 per byte transmitted. Government and bulk rates are TBD. Signatory countries to the ORBCOMM useage agreements are expected to approximate the following time-table:

1994-1995: Argentina, Brazil, Canada, Chile, Russia, S. Africa, Nigeria, Venezuela (Already have equipment)
1995-1996: Australia, Indonesia
1996-1997: Bolivia, China, Columbia, Ecuador, Hungary, Israel, S. Korea, Mexico, New Zealand, Panama
1997-1998: Algeria, Guatemala, Honduras, India, Japan, Morocco, Paraguay, Poland, Uruguay, Western Europe
1998-1999: Costa Rica, Egypt, Peru, Saudi Arabia, Thailand, Turkey, Zimbabwe
1999-2000: Kenya, Malaysia, Pakistan
2000-2001: Bangladesh, Iran, Madagascar, Mozambique, Sri Lanka, Uganda, Zaire

Advantages of using the ORBCOMM system for SOF support are:

1) When the system is operational, it can supply the means of relaying METOC sensor data to Forecast centers and Gridded Forecast data from the forecast centers to deployed WETMs worldwide at all times.
2) Short digital burst communications provide low probability of detection and intercept (LPD/LPI).
3) Its uplink frequencies are such that the IREMBASS METOC sensor package can communicate sensor data directly to any forecast center in the world in real time.

Disadvantage of using ORBCOMM for SOF support are:

Usage charges are based on the number of bytes transmitted and the charges may be too high for operational exploitation or exercise support.

3.2.6.3 IRIDIUM

The IRIDIUM system is a world-wide, personal, satellite telephone communications system. The system is being financed by a private international consortium of telecommunications and industrial companies, and is expected to become operational in 1998. Motorola is the prime contractor. Subscribers will use pocket-size, hand-held IRIDIUM telephones transmitting through digital facilities to communicate with any other telephone in the world. The satellite based system will track the location of the telephone handset, providing global transmissions even if the subscriber's location is unknown. In areas where compatible cellular service is available, the dual-mode phone will provide the option of transmitting a call via the cellular system.

The IRIDIUM network will comprise a constellation of 66 satellites in low earth orbit (LEO), about 420 nautical miles above the earth's surface. Compared to Geosynchronous satellites (22,300 nm), the LEO allows more tightly focused beams to be projected on the ground, ensuring strong signals and communication quality. The Space Segment will consist of 6 orbital planes, 11 operational satellites and one on-orbit spare per plane. The satellites will project 48 spot beams within their earth footprint for high signal quality and spectral efficiency with 16 dB margin. Echo is minimized, and the subscriber antenna is small enough to be carried on a hand-held subscriber unit. Small, lightweight satellites (about 1500 lbs) will be electronically interconnected to provide continuous worldwide coverage. Communications will be relayed via satellite and through terrestrial gateways where billing information and user location data will be stored. Once an IRIDIUM telephone is activated, the nearest satellite, in conjunction with the IRIDIUM network, automatically will determine account validity and the location of the user. The subscriber will select among cellular or satellite transmission alternatives, depending on compatibility and system availability, to dispatch a telephone call. If the subscriber's local cellular system is not available, the telephone will communicate directly with a satellite overhead and transfer the call from satellite to satellite through the network to its destination, either another IRIDIUM telephone, or an IRIDIUM ground station. IRIDIUM system gateways interconnect the satellite network with land-based fixed or wireless infrastructures including Public Switched Telephone Networks (PSTNs) worldwide.

The IRIDIUM network currently calls for a satellite launch schedule to begin in 1997; with commercial service commencing in 1998. In 1992, the Federal Communications Commission awarded Motorola an experimental license to construct and launch the first five satellites to demonstrate system feasibility. Iridium, Inc., since has signed a $3.37 billion contract to purchase the IRIDIUM Space System from Motorola's Satellite Communications Division. Lockheed Corporation will design and construct the satellite bus, which will be shipped to Motorola's facilities in Chandler, Arizona, where communications hardware and other components will be integrated.

Among many other Motorola subcontractors, Raytheon Corporation will design the phased array antenna for communication between ground stations and IRIDIUM telephones in L-Band. The Canadian firm, COMDEV, will develop hardware for intersatellite conversation in Ka-Band. Martin Marietta, Bechtel, Scientific Atlanta, Siemens and Telespazio also will provide key elements of the system.

McDonnell Douglas Corporation will launch the majority of the satellites on its Delta 2 vehicle. Khrunichev Enterprise of the Russian Federation also will provide launch services aboard its Proton vehicles, and China Great Wall Industry Corporation will provide services aboard its Long March IIc vehicles.

Applications of the IRIDIUM system to this SBIR are similar to the applications of the ORBCOMM system above except voice communications is also supported. If voice communications are used instead of short digital bursts, however, the system will no longer have the LPI/LPD advantages.

3.2.6.4 INMARSAT

The INMARSAT series of International Maritime communication Satellites stemmed from the requirements of the Intergovernmental Maritime Consultative Organization (IMCO) with 80 member nations. In 1975, IMCO formed the non-profit International Maritime Satellite Organization (INMARSAT) with 63 participating countries. Separate companies were formed in each of the participating countries. In the United States, Comsat Corporation is the US representative in the INMARSAT consortium. In 1982 INMARSAT took over the use of three MARISAT satellites and began service. Since then, the INMARSAT II series first launched in 1990 uses the design used for the European Communication Satellite (ECS) and MARECS. The number of ships using INMARSAT increases every year, both by choice and gradually due to governments' requirements that ships be equipped for satellite communications. In addition, since 1990, INMARSAT has provided service to airplanes as well as ships. Besides requiring increased satellite capacity, the airplanes also require more of the satellites' power because of their smaller antennas. The formal contract for INMARSAT III was signed in February 1991, and the first INMARSAT III launch will probably occur in 1995.

The INMARSAT II satellite configuration consists of one C to L band channel for shore to ship communications at 16 MHz bandwidth and four L to C band channels for ship to shore communications at 4.5, 4.5, 7.3 and 3.2 MHz bandwidths. This provides 250 two way voice telephone circuits, telex and data. Data may be transmitted at 2400 bps in voice channels, at 56 kbps or at rates up to 1 Mbps by specially equipped ships. Data rates of 56 Kbps and above are ship-to-shore only. The INMARSAT system is now composed of 4 regions with operational satellites located over the West Atlantic, East Atlantic, Indian Ocean, and Pacific. Several older

satellites are not currently operating, but one of them is in a leased mode for mobile truck traffic in North America. The satellites are owned or leased by INMARSAT and controlled at their headquarters in London. Ship stations are manufactured in various countries and type-certified by Inmarsat.

The advantages of using INMARSAT are:

1) Bandwidths and capabilities of the INMARSAT communications are adequate for relaying wideband video data, narrow band sensor and voice data to the JSOTF locations,
2) Near worldwide coverage is available within the 4 coverage zones.

The disadvantages of using the INMARSAT system are:

Lease and useage rates may be prohibitive. Each narrow band voice frequency telephone call including international charges at USG discounted rates is $6.25 per minute for standard A service and a portable A terminal rents for $2000 per month. Useage for wide band image transmission would be much higher.

3.3 Data Assimilation, Forecasting and Processing

3.3.1 Data Assimilation and Forecasting

Improvements in sensing densities in space and time from a variety of sensing platforms and at various time scales requires a relatively autonomous data assimilation capability at the theater level. The data assimilation capability must provide the flexibility to accomodate different sensor configurations based on the operational situation.

3.3.1.1 Local Area Prediction System Description

The National Oceanic and Atmospheric Administration's Forecast Systems Laboratory has been experimenting with a system called the Local Analysis and Prediction System (LAPS). This system was designed to handle the large volumes of data from diverse sensing sources, from surface sensors to pilot observations. The system was also focused on satisfying the mesoscale forecasting and product generation requirements that were not being met by smaller scale forecast models. LAPS produces quantitative gridded fields of wind, pressure, temperature, dewpoint, cloud base and top, precipitable water, cloud coverage and a variety of derived products such as lifting indices, vertical motion and the probability of severe weather.

LAPS includes both a data assimilation capability as well as links to full-physics atmospheric models that produce mesoscale forecast output. The data assimilation portion of LAPS includes the ingest of a first guess field provided from smaller scaled models such as that provided by the Mesoscale Analysis and Prediction System (MAPS) or the Nested Grid Model (NGM). This portion of LAPS also accommodates asynoptic observations from other sensors that are within the field of the analysis. The data sets that are assimilated within this portion of LAPS are then linked to the forecast models for continuous forecast updates on a time scale of once an hour.

LAPS has been in development and continuous use at the Forecast Systems Laboratory for nearly three years. It has been fed with data from the Colorado Mesonet a data dense sensor network that contains radars, automated commercial airline weather input, surface sensors and satellite input. LAPS has also been used outside the Colorado area in forecast experiments in the central United States (Kansas, Oklahoma, Missouri) and in the Southeast (Florida). LAPS has been connected to a variety of data sources including the Air Force Automated Weather Distribution System.

3.3.1.3 LAPS Timelines

Interviews with Dr. John McGinley, director of the LAPS Branch of the Forecast Systems Lab, indicate that the processing timelines associated with LAPS, linked to mesoscale models and existing hardware at the laboratory can produce hourly forecasts in just under an hour. The teimlines are not satisfactory if the desire is to provide sufficient reaction time to the weather customers who will need to analyze the information or develop products that can be sent on to other weather users. The data assimilation activity takes place very rapidly (seconds to minutes) whilethe mesoscale model that creates the forecast updates takes the bulk of processing time.

3.3.1.4 Applications of LAPS to this SBIR

The LAPS processing system appears to have the potential to provide in-theater data assimilation and forecasting capabilities that could conceptually support SOF activities. There are, however, some important areas of study that should be conducted to determine whether enhanced processing power, reduced data densities (as would be expected in a Special Operations mission environment, and timelines could provide better information than is already provided by lower fidelity models. The proposed SOCRATES/METOC architecture does not include processing power required by the LAPS system. State-of-the-art multiprocessor systems, discussed briefly in section 3.3.3, appear to offer the added processing power and small form factor that could operate a LAPS system and link to the existing SOCRATES/METOC architecture. Interviews with LtCol Coleman, the AFSOC branch weather chief and principal architect of the SOCRATES/METOC architecture indicate that thes types of hardware upgrades are expected during the course of system acquisition. It is less clear whether data densities could be created using the data sources described earlier in this section will be sufficient to drive LAPS and its

mesoscale model to reasonable output that can be applied by the SOF user, either a weather staff or a deployed force. As the title of this SBIR states, the passive sensing of meteorological parameters is one of the operational factors that must be considered in any system. One of the data sources that provides high density information to the LAPS operating at the Forecast Systems Laboratory is NEXRAD radar. Radar is not expected to be a useful data source for most Special Operations missions.

3.3.2 Weather Effect Decision Aids

Improving the ability of the weather staffs to perform their mission of providing improved forecasts and other products is an important part of the this SBIR. It was also important to examine how to provide the information to the deployed force at the time scales described in the first section of this SBIR and as described in the SOCOM METOC Study. Producing higher fidelity forecasts using the systems described in this section does not provide updated weather information to the deployed weather customer group. Tactical decision aids (TDAs) depict the effect of weather on operations and systems in simple easy-to-understand messages or graphic displays that enable a commander, planner or weather staff to evaluate the impact of weather. The TDA does not make decisions but adds to the commander's knowledge of the weather situation as it could impact operations.

The Army Research Laboratory's Battlefield Environment Directorate and Science and Technology Corporation (STC) produced a system called the Integrated Weather Effects Decision Aid. This system took a new look at the decision aid creation and display environment. The IWEDA system translates weather forecast inputs into useable weather products from mission level to the lowest component levels. This weather effects system consists of a number of software modules, including a knowledge-based expert system containing over 360 rules for 41 systems. IWEDA operates in a Windows 3.1 environment making it immediately useable on the PC laptop systems that are part of the SOCRATES/METOC architecture. The software was developed using ANSI C and C++ programming languages and is therefore a reasonable candidate for re-hosting on other operating systems (e.g. UNIX). IWEDA represents tactical missions that are defined as collections of systems. Systems include subsystems which are comprised of components. Figure 3.3.2-1 shows this structured break out. The idea is to allow the user to see the impact of forecast weather on missions and further step into the mission systems, subsystems and components to examine the impact of those subsets on the mission. This unique ability allows the user to determine which missions are impacted by weather and why it is effected.

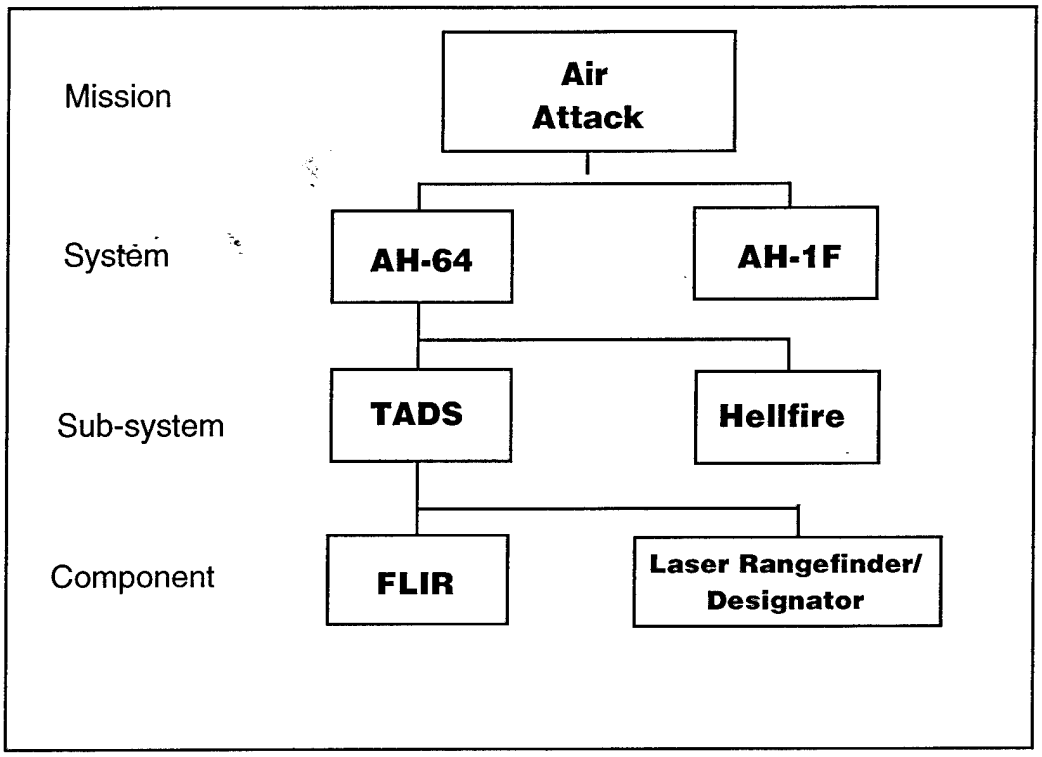


Figure 3.3.2-1 Weather Effects Model (from Chesley,et al., 1993)

During this SBIR the team had the opportunity to examine the IWEDA system as it had been developed for Army users, principally the Army's III Corps. The system could be configured to provide different levels of support from the weather forecaster, mission planners and the commander. The concept for Army application of IWEDA was to use the Army's Integrated Meteorological System (IMETS) to perform the data collection and processing and provide the data in a format that was digestible to the IWEDA system.

3.3.2.1 Application of IWEDA to this SBIR

IWEDA could be used in much the same way as envisioned for the Army with the replacement of the IMETS with the SOCRATES/METOC modules. IWEDA could operate in support of both customer groups with a SOF oriented weather effects system operating on both the weather staff modules as well as the deployed users laptop. This link is particularly important if the enhanced forecast data is to be applied within the time constraints of the operational forces. The weather staff could use their weather effects package to provide better input to the planning staffs and commanders as well as quality control check the information that could be produced in the field. The deployed user would be able to select the systems or operations that they plan to conduct, at

the time and space scales of interest to them, and given improved forecast grids from the LAPS system take advantage of the higher resolution information.

3.3.2.2 Proposed IWEDA Enhancements

The IWEDA system is designed to support the mission and systems associated with an Army Corps. It was also developed as a proof-of-concept system with user interface issues generally assumed to be provided as part of larger command and control systems for the Army. The following modifications are recommended for applicaiton of a similar system for Special Operations:

1) Build a rule set that focuses on Special Operations systems and missions. Some of the systems that were part of the original Army system could migrate directly while others would have to be modified or created. The systems and operations that are included in this rule set should be the result of collaboration with both customer groups, the weather staffs and the deployed force user.
2) Develop the capability to automatically ingest forecast grids from the LAPS system. The current IWEDA requires manual input of forecast fields. In the more dynamic environment envisioned by this SBIR where forecasts are provided at much higher fidelity in time and space, it will be important to automate the data ingest, particularly for the deployed user who will not have the time to perform that function.
3) Provide a geographic display that matches the geographic displays of the operating forces. Higher resolution forecast products will be most valuable if displayed on geographic displays that match the resolution of the gridded forecast.
4) Consider including possible threat systems that might be used against Special Operations Forces and include in the weather effects system a means of comparing friendly versus threat capabilities based on environmental conditions.

3.4 Processing Systems

One of the components that the SBIR team intended to evaluate were possible processing systems that could be used for improved data processing and information display. The SOCRATES/METOC architecture processing hardware acquisition is solving most of the processing requirements of the weather staffs. The addition of a Local Area Prediction System into that processing architecture, as described in this SBIR, will require more processing power than was envisioned at the time the SOCRATES/METOC architecture was built. The SOCOM approach to the acquisition of the architecture, as expressed by Lt Col Coleman, was to evaluate the state-of-the-art computer systems and make purchase decisions closer to the time of actual acquisition and to keep the systems open and accessible through the use of standard practice operating systems and applications.

With that in mind the team limited its processing review to those systems that would be required, beyond those already planned by SOCOM, to implement the components described in this report. The two major additional processing elements added to the SOCRATES/METOC architecture are the LAPS system and a weather effects display system. The LAPS system is projected to operate on an in-theater UNIX based computer. The weather effects system is projected to operate on any laptop or desktop PC using a DOS/Windows environment. The laptop systems as described in the existing METOC architecture will be able to accommodate the weather effects products without modification. Introducing LAPS into the theater will require, however, a substantial processing upgrade to the planned UNIX systems at that level.

The team examined a number of processing options and discussed them Forecast Systems Laboratory to determine their viability with regard to operating a real-time LAPS system for SOCOM. As with the sensor evaluations, the criteria for use included size, cost and capabilities. Two commercial systems became possible candidates for use in further experiments; the Maxion computer built by Concurrent Computer Corporation, and the Quadrics Supercomputer built by Alenia Spazio. Both systems can be linked to UNIX based processing systems, such as those planned in the SOCOM architecture.

3.4.1 Concurrent Maxion System

The Concurrent Maxion System became a candidate for this SBIR because of its unique multiprocessor and data pathway design. It was also unique in that its small size and relatively low cost made it a reachable option from cost and form factor perspectives. The Air Force is also working with Concurrent to reduce the form factor of this commercial system even further so that it could fit into an aircraft. The system operates a real-time version of the UNIX operating system and has been used for a variety of meteorological systems such as the Navy's TESS upgrades. The cost of this system is estimated at $70K. Its size could be as small as a desktop computer or less for the custom system being built for the Air Force cockpit application.

A Maxion is scheduled for integration and testing at the Forecast Systems Laboratory in January 1995. The FSL staff believe it fits the form and cost targets that they are striving for in the application of local forecast models at weather stations.

3.4.2 Alenia Quadrics Supercomputer

Another possible processing option for the high fidelity forecast model is the Alenia Quadrics Supercomputer. This system, built by the Italian aerospace firm Alenia Spazio, is described as a scalable supercomputer. It is designed to operate in a desktop environment and can be scaled in the sense that additional processors can be added to the system to tailor it to the specific application. This system is now in use in Europe as a platform to run mesoscale forecast models.

The system uses a Tao operating system that can be linked to a UNIX front end as the user interface. The scalability of this system and its relatively small form factor (desktop size and air cooled) made it a possible option for experimentation at the Forecast Systems Laboratory.

3.4.3 Processing Systems Applied to this SBIR

The processing systems examined for this SBIR were limited to a cursory review of possible systems that could perform the high fidelity forecasting function without seriously impacting the size, cost or existing srchitectures planned by SOCOM. Of the two candidates that became the most desireable, the Concurrent Maxion system appears to be the most viable from both a technical and cost perspective. The system operates in a UNIX environment, the system is available for testing at the Forecast Systems Laboratory immediately and at no cost, and the operating system more closely matches both the SOCRATES/METOC system and the systems operating at the Forecast Systems Laboratory. For these reasons, the Concurrent Maxion will be recommended for further test use.

3.5 SOCOM System Implementation

Figure 3.5-1 depicts a typical deployment of the prototype high resolution weather system proposed for field testing in phase II of this SBIR. The deployment shown supports the concept of providing METOC data inputs and timely forecast product outputs to the deployed weather teams where high resolution weather satellite imagery and surface weather data can be collected, displayed and analyzed during mission planning or actual operations. The operational scenario assumes the mission commander, METOC Base Station and the JSOTF aboard an aircraft carrier off shore and over the horizon from the beach-head operations area of interest.

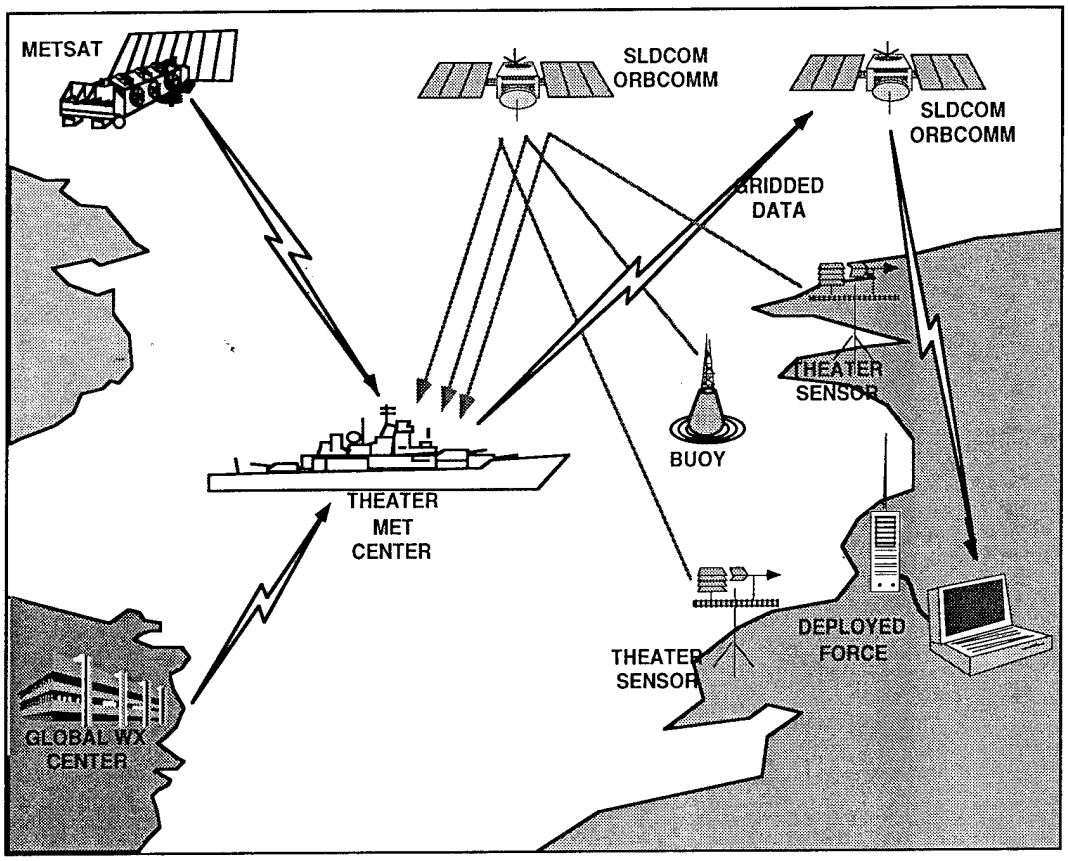
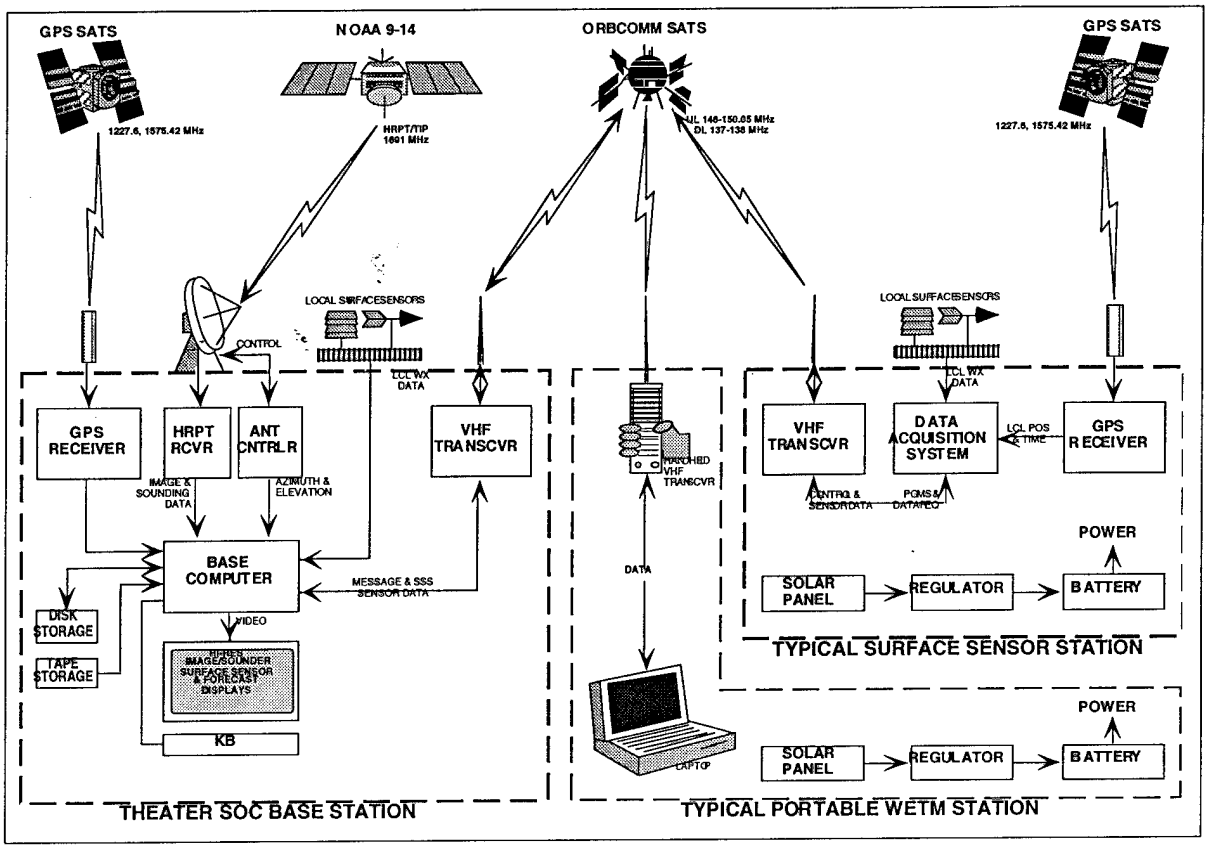


Figure 3.5-1 Conceptual SOCOM Weather System

The Base station will require access to a regional GES for ORBCOMM system usage, however, since each satellite has a 3,000 KM diameter footprint on the ground, a NCC/GES can be placed in Theater Rear or Staging area. For example an NCC/GES in Japan can cover the Korean peninsula. If an ORBCOMM NCC/GES is not close enough to the area of interest, it could be carried aboard the carrier. Multiple SSSs are deployed at various places in or around the operational area and configured for the surface weather data required at the particular location. The NOAA 9 to 14 satellites' Visible/IR sensors require simultaneous visibility of the base station for real-time high-resolution weather imagery transmission and the area of interest for imagery data acquisition. Surface sensor data is transmitted over the ORBCOMM network, or until the ORBCOM system is in place, by the SLDCOM constellation, either plain text or encrypted. Good planning would require measurement of the surface data at a time corresponding to the midpoint of the real-time NOAA imagery and sounder measurements. Surface data collection and transmissions from the SSSs can be remotely programmed by the BS either prior to deployment or after deployment to occur at the desired times based on updated NOAA satellite ephemerides and operational planning.

Once the surface sensor data is fused with the high resolution magery at the base station, the forecast products are generated in the form of gridded data fields, and are transmitted to a deployed force where they are displayed in the form of weather effects IWEDA weather effects data. This data is then sent in narrow band form from the BS to the Portable WETM Stations (PWS) where they are analyzed, displayed and overlaid by the SOF WETM on gridded maps pre-resident on the laptop's hard drive. Digital communications is also available from the BS and the WETM hand held unit.

Figure 3.5-2 is a conceptual block diagram of the BS, a typical SSS and a WETM Portable Field Station. The BS must have a high gain tracking antenna to receive the wide-band, high data rate, digital HRPT and TIPS data from the TIROS - N (or DMSP). The GPS antenna is a small stub about 4" high and 1" in diameter and easily mounted in both the fixed and portable installations. The ORBCOMM antenna is a 52 cm vertical whip. ORBCOMM transmissions are short digital burst packets at a rate of 2400 bits per second over one of 820 possible (dynamically selected) 10 KHz channels, with inherent low probabilities of intercept and detection. The BS is equipped with high capacity disk and tape storage units for temporary and permanent data storage. Application programs exist for use in data collection, display, analysis and storage, tracking antenna control, SSS communications, programming and control, operations planning and scheduling. SSSs are unlimited in number and surface sensor configuration. In fact, since the ORBCOM up link frequency and power requirements are the same as the IREMBASS transmitter, the IREMBASS unit could be used directly for communications with the ORBCOMM satellites, thus increasing the IREMBASS range from 15 miles per repeater to world-wide with no repeaters required. Data communications (encrypted if required) via ORBCOMM between SSSs and from any SSS and the BS (or anywhere else in the world) is supported more than 95% of the time anywhere in the world, and a delay of less than two minutes may occur the rest of the time.



SOF HI-RES WX SYSTEM WITH TIROS, GPS AND ORBCOMM

Figure 3.5-2

4.0 EXERCISE APPLICATIONS

One of the desires expressed at early meetings on this SBIR study was to apply the technologies and systems reviewed in during Phase I for an exercise. Hamlets Cove activities and exercises were proposed as a possible exercise alternative. Hamlets Cove is an on-going activity that focuses on mine detection. The activities and exercises that support Hamlets Cove are planned for implementation from the present to 1998 making them a reasonable candidate for a Phase II implementation of a prototype of the an enhanced weather system. The initial test site for Hamlets Cove is located at Hurlburt AFB, Florida. This coincides with the location of the AFSOC meteorological staff and the SOCRATES/METOC architecture development and testing location making it ideal for testing a weather prototype. The Hurlburt site is also within ORBCOMM and SLDCOM communication distance from McDill AFB and the COMNAVMETOCOM staff located there. This opens a variety of possible Phase II implementation sites that could permit the application of a prototype system and an assessment of the output and products by the key weather customer groups identified earlier in this study. Locating the test site near Hurlburt may also allow the exploitation of sensors at the airfields along the Florida coast to test various data densities and reporting rates without having to purchase sensors for a follow-on study. Interviews with LtCol Coleman (AFSOC) out of Hurlburt and LCDR Clendenning (COMNAVMETOCOM) indicated their support of follow-on exercise support activity carried out with their participation and support.

Figure 4.0-1 shows a notional three day timeline with satellite pass times or image refresh for GOES satellites, sensors and communications systems availability. This notional timeline depicts the types of systems that would be examined over a three day exercise to determine the utility, value and cost of implementing the different components proposed in this SBIR. Figure 4.0-2 shows a blow up of a one day period from this section. The most striking comparisons that can be made from these two timelines are those related to communcations systems. The value of more continuous communications between the sensors, the base station and the weather effects display systems is an item for investigation during follow-on work.

Figure 4.0-1 Three Day Exercise Schedule - Hurlburt FL

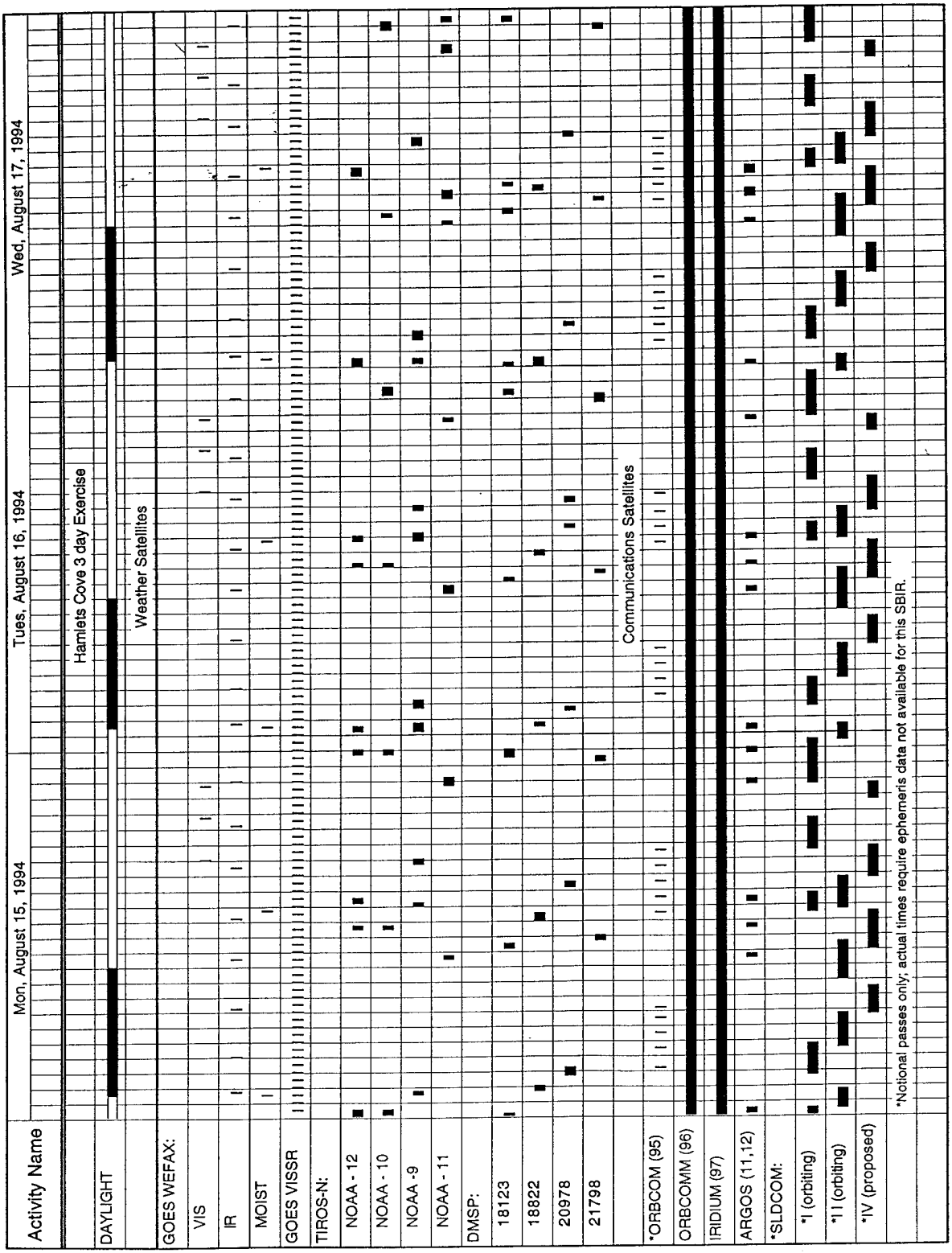
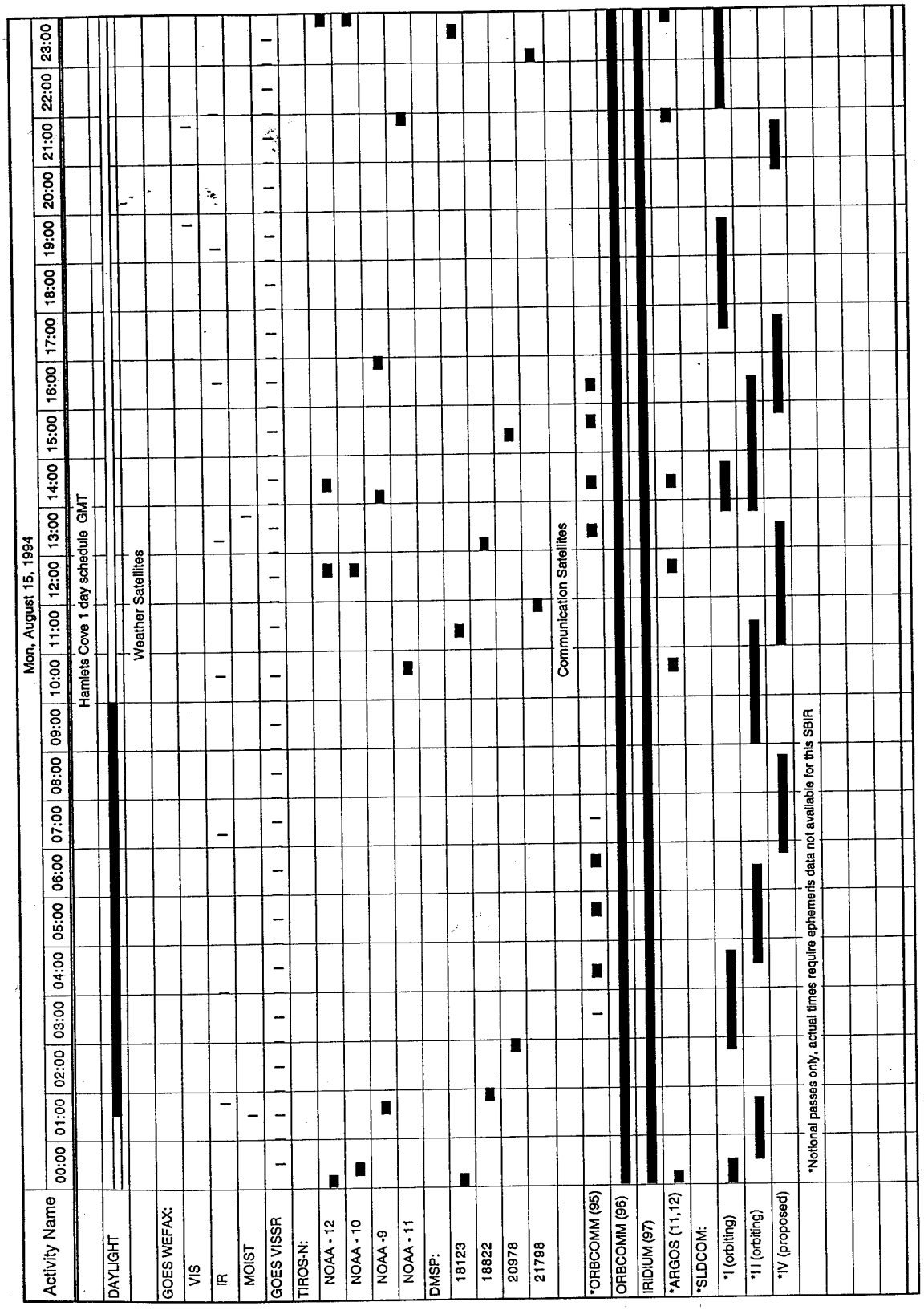


Figure 4.0-2 One Day Exercise Schedule Extract - Hurlburt FL



5.0 Conclusions and Recommendations

This SBIR examined a large number of possible enhancements to the SOCOM meteorological sensing and processing architecture (SOCRATES/METOC). The enhancements were oriented toward satisfying the extreme environmental data requirements in terms of accuracy and refresh rates. An underlying assumption in the study is that these environmental data parameters were required over the entire operational area. The challenges of improving the output of the SOCRATES METOC architecture and any environmental sensing architecture is to sense the environmental parameters at greater densities in time and space, transmit those sensed values to a site from which the data can be exploited within the timelines of user requirements

5.1 Conclusions

Many of the components and data sources, shown in figure 9.1, required to improve the SOCRATES/METOC system are available now, or will be available over the next two to five years.

The greatest component shortfall to improve the meteorological architecture is the surface sensor components. Commercial sensors provide some capabilities but their size, weight and power consumption make them impractical for Special Operations Force deployment.

Satellite communications systems that are projected or are currently in place will be able to improve the timeliness of sensor data delivery to processing nodes.

A combination sensor/satellite data communications package is required to achieve the improved data reporting requirements. Small sensors are being examined at a number of laboratories but are not linked to equally small transmission systems.

Data assimilation systems and forecast models have been employed in various parts of the United States using a variety of input data from global and local sources to produce local forecast products. The system operating at the NOAA Forecast Systems Laboratory is being modified to operate in an open system environment and on multiprocessor computing systems.

First estimates of processing capabilities indicate that data assimilation and forecast models can be accommodated on small multiprocessor computing systems. These computing systems are small enough to be deployed as part of a theater level meteorological unit.

A theater (JSOTF level) data assimilation system is required to effectively exploit the sensed information as it arrives from the variety of sources available. This assimilation system must be

more than a data overlay and display system. The system must be able to time order the observations and sensibly apply them in mesoscale models.

Delivery of enhanced meteorological information and products to deployed forces must be addressed if the timelines of the data requirements listed in Appendix A are to be achieved. Tactical decision aid products have been used for a number of years and their extension to time sequenced geographic displays of weather impact on critical systems or missions may be the best method of updating deployed forces.

5.2 Recommendations

The systems and components reviewed as part of this SBIR are only parts of a more comprehensive satisfaction of environmental parameters described in section 2 and in Appendix A. Many of the components have only been tested in laboratory environments or, as is the case for the data assimilation and forecast system used by the NOAA Forecast Systems Laboratory, in data rich environments. The baseline meteorological support architecture for SOCOM is also evolving in significant ways over the next five years with new processing and satellite receive capabilities. Based on the conclusions of this study and the experimental and/or evolutionary nature of the components the following recommendations are submitted:

1) Establish a test bed wherein the components of the SOCRATES/METOC architecture can be installed and modified to include components examined in this study.

2) Migrate the data assimilation system and forecast model from the laboratory environment to a processing system that can be linked to data sources and processing systems of the SOCRATES/METOC architecture. Evaluate the performance of this type of system in terms of timelines, forecast accuracy improvements, product output and spatial fidelity.

3) Produce a Special Operations weather effects display system that can automatically ingest gridded data from the forecast system and display information at the request of the deployed user.

4) Evaluate the performance of the data assimilation and forecast system using a variety of sensor types, densities and reporting rates. Tie the reporting rates to the types of communcations systems likely to be used for the purpose of sensor data transmission.

5) Provide for post analysis and quality control checks of the theater forecast products by independent analysts.

6) Involve both customer groups, the meteorological staffs and the deployed weather user, in identifying and evaluating the weather information displays and products. This evaluation should include both utility and accuracy of the information.

7) Deploy the system in support of exercises to test its utility beyond the test bed environment.

8) Evaluate other types of environmental information display opportunities that exhibit the same types of requirements and constraints as those imposed for meteorological purposes as evaluated in this study. These opportunities may involve other services, missions and environmental parameters. For example, the proposed in theater atmospheric modeling could be extended to oceanographic modeling and support or specifically oriented toward littoral warfare regions.

9) Explore other "deployed force" requirements. Instead of laptop systems as the receiver of enhanced data, the deployed force may be a command and control system or mission planning system that could fed updated environmental information. The deployed force could be a simulation or gaming activity that requires the generation of synthetic environments. These synthetic environments could also be applied to simulators that provide more realistic feedback to the operators of the simulator.

APPENDIX A - SOCOM METOC REQUIREMENTS

A.1 Meteorological Requirements

A.1.1 Atmospheric Conditions [1]

Data Element	Accuracy	Refresh Rate
1. Acoustic Propagation	Not Specified	1 hr
2. Altimeter Setting	+/- 0.03 in HG or +/- 1 MB or +/- 30 ft	2 hr
3. Atmospheric Contaminants	Not Specified	3 hr
4. Atmospheric Density	+/- 1% of STD ICAO Atmosphere	3 hr
5. Barometric Pressure	+/- 1 MB	15 min.
6. Cloud Cover Amount	+/- 10% of Layer Cover	15 min.
7. Cloud Base Height	+/- 50 M (SFC < 1000 ft) +/- 5 % (> 1000 ft)	15 min. 15 min.
8. Cloud Top Height	+/- 50 FT (100-1000 ft) +/- 100FT (SFC - 5000 ft) +/- 5% (>5000 ft)	15 min.
9. Damaging Winds (SW)	+/- 5 kts and 5 Deg. (>13 KTS)	5 min.
10. Density Altitude	+/- 1.7 m	1 hr
11. Dew Formation	+/- 1 hr	3 hr
12. Extinction Coefficient	+/- 10%	3 hr
13. Extreme Heat/Cold (SW)	+/- 1 deg. C, Range: <-32, >35 C	15 min.
14. Freezing Precipitation (SW)	Any occurrence	5 min.
15. Heavy Rain/Snow	+/- .25 CM (Liquid) +/- 1.25 CM (Frozen)	15 min.
16. Humidity, Absolute, Surface	+/- 10 %	15 min.
17. Humidity, Absolute, Profile	+/- 10 %	15 min.
18. Humidity, Relative	+/- 5 %	15 min.
19. Humidity, Relative, Profile	+/- 5 %	15 min.
20. Hurricanes/Typhoons (SW)	+/- 2 km (eye location)	5 min.
21. Icing, Flight (SW)	+/- 1 category	5 min.
22. Illumination	+/- .001 ftcndls	30 min.
23. IR Target/Background	+/- 1.25 deg. F.	30 min.

Contrast		
24. IR Thermal Contrast X-over time	+/- 15 min.	15 min.
25. Ionospheric Disturbance	+/- 1 category upon occurrence	12 hr
26. Light Data (solar/lunar,	+/- 1 degree AZ and EL)	N/A +/- 1 % lunar phase
27. Lightning/Thunderstorms(SW)	+/- 0.5 mi of location	5 min.
28. Precipitation, Accumulation	+/- 0.25 cm/hr (liquid) +/- 1.25 cm (frozen)	15 min.
29. Precipitation, Rate	+/- 0.25 cm/hr (liquid) +/- 1.25 cm (frozen)	15 min.
30. Precipitation, Hail Size	any occurrence > 0.6 cm	5 min.
31. Precipitaition, Type	by type	15 min.
32. Pressure Altitude	+/- 9 m	15 min.
33. Refractive Index	N/S	15 min.
34. Restriction to Visibility	+/- 10 % of range, cause of restriction	15 min.
35. Seeability	+/- 10 % of range, - Ultraviolet - Infrared - Millimeter Wave - Multispectral	15 min.
36. Severe Weather Conditions (SW)	Notify time ASAP	5 min.
37. Solar Radiation	N/A	30 min.
38. Stability Index	=/- 1 Pasquill category	1 hr.
39. Static Electricity Potential	N/S	5 min.
40. Temperature, Air, Surface	+/- 1 deg. C	15 min.
41. Temperature, Air, Profile	+/- 1 deg. C	15 min.
42. Temperature, Air, Upper Air	+/- 1 deg. C	15 min.
43. Temperature, Dewpoint	+/- 1 deg. C	15 min.
44. Temperature, Dewpoint, Profile	+/- 1 deg. C	15 min.
45. Temperature, Eq Wind Chill Index	+/- 3 deg. C	15 min.
46. Temperature, Inversion Level(s)	+/- 50 ft +/- 50 ft < 300 ft AGL +/- 150 ft > 300 ft AGL	30 min.
47. Temperature, WBGT	+/- 1 deg. C	30 min.
48. Tornado (SW)	+/- 0.5 mi. of location	5 min.

49. Turbulence, Flight	+/- 1 category	15 min.
50. Turbulence, Optical	N/S	30 min.
51. Visibility, Visible Spectrum	+/- 10 % of range	15 min.
52. Wind, Profile	+/- 10 deg.	15 min.
	+/- 1 kt	
53. Wind, Shear	N/S	15 min.
54. Wind, Surface,	+/- 10 deg.	15 min.
Speed / Direction	+/- kt	
55. Wind, Surface, Gust Speed	+/- 18 deg.	15 min.
	+/- 2 kt	
56. Wind, Surface, Gust Spread	actual spread	15 min.
57. Wind, Upper Air,	+/- 10 deg.	15 min.
Speed / Direction	+/- 5 % < 20 kts	
	+/- 1 kt	
58. Albedo	N/S	1hr.
59. IR Transmissivity	+/- 20 %	5 min.

A.2 Oceanographic Requirements

The following horizontal resolution requirements for Sea Floor, Water Column, and Ocean Dynamics parameters submitted by NAVSPECWARCOM are:

5 meters inside a 10 fathom curve.
10 meters between 10 and 50 fathom curves
25 meters between 50 and 100 fathom curves

A.2.1 Sea Floor Properties [1]

Data Element	Accuracy	Refresh Rate
1. Water Depth	N/S	N/S
2. Bottom Gradient	+/- 1 deg. within 10 fm.	N/S
3. Bottom Composition	N/S	N/S

A.2.2 Water Column Properties [1]

Data Element	Accuracy	Refresh Rate
1. Surface Temperature	+/- 1 deg. C	1 hr.
2. Temperature Profile	N/S	N/S
3. Water Turbidity / Visibility	+/- 1 m	1 hr.

4. Temperature, Water, Inland	+/- 1 deg. C	1 hr.
5. Bioluminescence	N/S	1 hr.
6. Hazardous Marine Life	N/S	N/S
7. Water Density (sigma - T)	N/S	N/S
8. Water Salinity	N/S	N/S

A.2.3 Ocean Dynamics [1]

Data Element	Accuracy	Refresh Rate
1. Current Direction, Near Shore / Littoral	+/- 5 deg.	1 hr.
2. Current Speed, Near Shore / Littoral	+/- 0.1 kt	1 hr.
3. Current Measurement Time, Near Shore / Littoral	+/- 15 min.	1 hr.
4. Wave Periodicity (wind waves)	N/S	1 hr.
5. Wave Direction (wind waves)	+/- 10 deg.	1 hr.
6. Wave Height (wind waves)	+/- 30 cm.	1 hr.
7. Breaker Height	+/- 30 cm.	1 hr.
8. Breaker Period	N/S	1 hr.
9. Breaker Type, Percent Plunging	N/S	1 hr.
10. Breaker Type, Percent Spilling	N/S	1 hr.
11. Breaker Angle to Beach	N/S	1 hr.
12. Width of Surf Zone	N/S	1 hr.
13. Number of Lines of Surf	N/S	1 hr.
14. RIP Current	N/S	1 hr.
15. Swell Direction	+/- 10 deg.	1 hr.
16. Swell Height	+/- 30 cm.	1 hr.
17. Tide Height, Ocean	+/- 0.5 m.	1 hr.
18. Tide Time, Ocean	+/- 15 min.	1 hr.

A.3 Planning Factors [1]

A.3.1 Ground State Conditions [1]

Data Element	Accuracy	Refresh Rate
1. Flooding, River Stage	+/- 1 standard deviation	1 hr.
2. Freeze / Thaw Depth	+/- 2.5 cm. to depth of 20 cm.	6 hr.
3. Ice / Snow Depth	+/- 1.25 cm.	1 hr.
4. Ice / Snow Cover	+/- 10 % coverage	1 hr.

5. Snow State Condition	Metamorphic Condition	1 hr.
6. Snowdrift Depth	+/- 15 cm.	6 hr.
7. Soil / Ground Moisture	+/- 5 % of moisture content to depth of 20 cm.	30 min.
8. Soil / Ground Temperature	+/- 1 degree C	30 min.
9. Standing Water / Pooling	Estimate	1 hr.

Many of the above ground state conditions, if we know what the precipitation has been and are forecast to be over an area we should be able to forecast stream flows, flooding conditions, snow depth, standing water, etc. The Army's Integrated Weather Effects Decision Aid (IWEDA) can display current or forecast environmental effects in each operational area of interest. This is true for all types of vehicles and weapon systems being considered. An IWEDA display where-in the environmental effects forecast would overlay the standard maps of the area on a lap-top computer would be quite useful for making SOF operational decisions.

A.3.2 Coastal / Riverine Conditions [1]

NAVSPECWARCOM states 5 meter horizontal resolution requirements for Coastal / Riverine parameters.

Data Element	Accuracy	Refresh Rate
1. Beach Width	N/S	Daily
2. Beach Type	N/S	N/S
3. Beach Obstacle Type	N/S	N/S
4. Beach Obstacle Location	N/S	N/S
5. Beach Trafficability	N/S	Daily
6. Coastal Vegetation	N/S	N/S
7. River Depth	N/S	N/S
8. River Width	N/S	N/S
9. Riverine Bottom Gradient	N/S	N/S
10. River Obstacle Type	N/S	N/S
11. River Obstacle Location	N/S	N/S
12. Rapids Location	N/S	N/S
13. Riverine Vegetation	N/S	N/S
14. Shoal Location	N/S	N/S
15. River Flow Speed	+/- 0.1 kt	30 min.
16. River Flow Direction	Up/Down River	30 min.
17. River Flow Measurement Time	+/- 15 min.	30 min.
18. River Temperature	N/S	N/S
19. Pollution Type	N/S	N/S
20. Pollution Level	N/S	N/S

21. Hazardous Animal Life	N/S	N/S
22. Tide Height, Riverine	+/- 0.5 m	30 min.
23. Tide Time, Riverine	+/- 15 min.	30 min.

A.3.3 Sea Floor Properties

NAVSPECWARCOM stated horizontal resolution requirements for Sea Floor parameters as follows:

5 meters inside a 10 fathom curve
10 meters between 10 and 50 fathom curves
25 meters between 50 and 100 fathom curves

Data Element	Accuracy	Refresh Rate
1. Underwater Obstacle Type	N/S	N/S
2. Underwater Obstacle Location	N/S	N/S
3. Mine-like Object Location	N/S	N/S
4. Wreck Location	N/S	N/S
5. Underwater Cable Type	N/S	N/S
6. Underwater Cable Route	N/S	N/S
7. Underwater Trench Location	N/S	N/S
8. Underwater Trench Depth	N/S	N/S

APPENDIX B - METEOROLOGICAL SENSORS AND SYSTEMS

See attached forms

Equipment by Requirement Category

==========

Reference: 3.1.1.02a Altimeter setting
Required Accuracy: 0.03 in Hg
Required Refresh Rate: 60 (min)

==========

AIR (Atmo Inst Rsch) Model: DB-1A System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: High Range:
Accuracy: .01 in Hg Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

Scientific Sales Model: AIR-HB-1A/2A/1F System: 01
Length: 3.0 (cm) Width: 9.1 (cm) Height: 14.5 (cm)
Diameter: 0.0 (cm) Volume: 395.9 (cm3) Weight: .28 (kg)
Low Range: 17.7 High Range: 32.5 in Hg
Accuracy: .02 in Hg Refresh Rate: continuous
Sensor type:
Power consumption: Stand. 9 V Alk Battery Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-1B System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: High Range:
Accuracy: .02 in Hg Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-2A System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: High Range:
Accuracy: .02 in Hg Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-1C System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: High Range:
Accuracy: .02 in Hg Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.1.1.02a Altimeter setting
Required Accuracy: 0.03 in Hg
Required Refresh Rate: 60 (min)

==========

AIR (Atmo Inst Rsch) Model: DB-2B System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: High Range:
Accuracy: .02 in Hg Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-3A System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: High Range:
Accuracy: .02 in Hg Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-3B System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: High Range:
Accuracy: .02 in Hg Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-2C System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: High Range:
Accuracy: .03 in Hg Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-3C System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: High Range:
Accuracy: .03 in Hg Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.02a Altimeter setting
Required Accuracy: 0.03 in Hg
Required Refresh Rate: 60 (min)

Reference: 3.1.1.02b Altimeter setting
Required Accuracy: 1 mb
Required Refresh Rate: 60 (min)

AIR (Atmo Inst Rsch) Model: DB-1A System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 800.0 High Range: 1060.0 mb
Accuracy: .30 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

Scientific Sales Model: AIR-HB-1A/2A/1F System: 02
Length: 3.0 (cm) Width: 9.1 (cm) Height: 14.5 (cm)
Diameter: 0.0 (cm) Volume: 395.9 (cm3) Weight: .28 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .50 mb Refresh Rate: continuous
Sensor type:
Power consumption: Stand. 9 V Alk Battery Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-1B System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .50 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-2A System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 800.0 High Range: 1060.0 mb
Accuracy: .50 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.02b Altimeter setting
Required Accuracy: 1 mb
Required Refresh Rate: 60 (min)

AIR (Atmo Inst Rsch) Model: DB-1C System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 1.0 High Range: 1100.0 mb
Accuracy: .60 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-2B System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .70 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-3A System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 800.0 High Range: 1060.0 mb
Accuracy: .70 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-3B System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .80 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-2C System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 1.0 High Range: 1100.0 mb
Accuracy: .90 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

```
=====================================================================
Reference: 3.1.1.02b   Altimeter setting
      Required Accuracy: 1 mb
      Required Refresh Rate:   60 (min)
=====================================================================

AIR (Atmo Inst Rsch)   Model: DB-3C                        System:  02
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   8.9 (cm)
  Diameter:      8.9 (cm)  Volume:     553.7 (cm3)  Weight:    .59 (kg)
  Low Range:     1.0       High Range:  1100.0 mb
  Accuracy:      1.00 mb                    Refresh Rate: .1 SEC
  Sensor type: Dual diaphragm pressure sensor
  Power consumption: 11-16 VDC                  Moving parts: No

---------------------------------------------------------------------


=====================================================================
Reference: 3.1.1.02c   Altimeter setting
      Required Accuracy: 30 ft
      Required Refresh Rate:   60 (min)
=====================================================================

Scientific Sales       Model: AIR-HB-1A/2A/1F          System:  03
  Length:        3.0 (cm)  Width:        9.1 (cm)   Height:  14.5 (cm)
  Diameter:      0.0 (cm)  Volume:     395.9 (cm3)  Weight:    .28 (kg)
  Low Range: -2300.0       High Range: 13800.0 ft
  Accuracy:      1.00 ft                    Refresh Rate: continuous
  Sensor type:
  Power consumption: Stand. 9 V Alk Battery     Moving parts: No


AIR (Atmo Inst Rsch)   Model: DB-1A                        System:  03
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   8.9 (cm)
  Diameter:      8.9 (cm)  Volume:     553.7 (cm3)  Weight:    .59 (kg)
  Low Range: -1250.0       High Range:  6400.0 ft
  Accuracy:      8.00 ft                    Refresh Rate: .1 SEC
  Sensor type: Dual diaphragm pressure sensor
  Power consumption: 11-16 VDC                  Moving parts: No


AIR (Atmo Inst Rsch)   Model: DB-1B                        System:  03
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   8.9 (cm)
  Diameter:      8.9 (cm)  Volume:     553.7 (cm3)  Weight:    .59 (kg)
  Low Range: -2300.0       High Range: 13800.0 ft
  Accuracy:     13.00 ft                    Refresh Rate: .1 SEC
  Sensor type: Dual diaphragm pressure sensor
  Power consumption: 11-16 VDC                  Moving parts: No
```

Equipment by Requirement Category

Reference: 3.1.1.02c Altimeter setting
Required Accuracy: 30 ft
Required Refresh Rate: 60 (min)

AIR (Atmo Inst Rsch) Model: DB-2A System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: -1250.0 High Range: 6400.0 ft
Accuracy: 13.00 ft Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-1C System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: -2300.0 High Range:154000.0 ft
Accuracy: 16.00 ft Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-2B System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: -2300.0 High Range: 13800.0 ft
Accuracy: 19.00 ft Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-3A System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: -1250.0 High Range: 6400.0 ft
Accuracy: 19.00 ft Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-3B System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: -2300.0 High Range: 13800.0 ft
Accuracy: 21.00 ft Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

Equipment by Requirement Category

```
======================================================================
Reference: 3.1.1.02c   Altimeter setting
      Required Accuracy: 30 ft
      Required Refresh Rate:   60 (min)
======================================================================

AIR (Atmo Inst Rsch)   Model: DB-2C                        System:  03
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   8.9 (cm)
  Diameter:      8.9 (cm)  Volume:     553.7 (cm3)  Weight:    .59 (kg)
  Low Range: -2300.0       High Range:154000.0 ft
  Accuracy:     24.00 ft                    Refresh Rate: .1 SEC
  Sensor type: Dual diaphragm pressure sensor
  Power consumption: 11-16 VDC                  Moving parts: No


AIR (Atmo Inst Rsch)   Model: DB-3C                        System:  03
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   8.9 (cm)
  Diameter:      8.9 (cm)  Volume:     553.7 (cm3)  Weight:    .59 (kg)
  Low Range: -2300.0       High Range:154000.0 ft
  Accuracy:     27.00 ft                    Refresh Rate: .1 SEC
  Sensor type: Dual diaphragm pressure sensor
  Power consumption: 11-16 VDC                  Moving parts: No

----------------------------------------------------------------------


======================================================================
Reference: 3.1.1.05    Barometric pressure
      Required Accuracy: 1 mb
      Required Refresh Rate:   15 (min)
======================================================================

METOCEAN               Model: WOCE Drifter             System:  01
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  20.0 (cm)
  Diameter:      3.8 (cm)  Volume:     227.0 (cm3)  Weight:    .45 (kg)
  Low Range:               High Range:
  Accuracy:                                  Refresh Rate:
  Sensor type: Lagrangian Drifter (ARGOS)
  Power consumption: Battery                    Moving parts: No


Scientific Sales       Model: WeatherMax               System:  01
  Length:       25.0 (cm)  Width:       23.0 (cm)   Height:   9.0 (cm)
  Diameter:      0.0 (cm)  Volume:    5175.0 (cm3)  Weight:   2.00 (kg)
  Low Range:   931.0       High Range:  1060.0 mb
  Accuracy:                                  Refresh Rate:
  Sensor type:
  Power consumption: 12 VDC                     Moving parts: No
```

Equipment by Requirement Category

Reference: 3.1.1.05 Barometric pressure
Required Accuracy: 1 mb
Required Refresh Rate: 15 (min)

METOCEAN Model: Ice Platform System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 350.0 (cm)
Diameter: 69.0 (cm) Volume: 1308751.3 (cm3) Weight: 250.00 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type: TOGA style drifter (ARGOS)
Power consumption: Battery Moving parts: Yes

Paroscientific Model: 740 SERIES System: 00
Length: 6.4 (cm) Width: 15.4 (cm) Height: 15.9 (cm)
Diameter: 0.0 (cm) Volume: 1567.1 (cm3) Weight: .91 (kg)
Low Range: 800.0 High Range: 1100.0 mb
Accuracy: .01 % Refresh Rate:
Sensor type:
Power consumption: 5-28 VDC or 4AA batteries Moving parts: No

Handar Model: Barometer & Pressure Sen System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.3 (cm)
Diameter: 6.9 (cm) Volume: 311.6 (cm3) Weight: .26 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .05 mb Refresh Rate: N/A
Sensor type: var/cap cer
Power consumption: 22-30 VDC Moving parts: No

Qualimetrics Inc Model: 7100 Analog Output Baro System: 00
Length: 8.1 (cm) Width: 8.4 (cm) Height: 6.6 (cm)
Diameter: 0.0 (cm) Volume: 449.1 (cm3) Weight: .40 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .05 % Refresh Rate:
Sensor type: Variable capacitance ceramic cylinder
Power consumption: .2 W Moving parts: No

NovaLynx Model: 1522 System: 00
Length: 19.0 (cm) Width: 14.0 (cm) Height: 12.7 (cm)
Diameter: 0.0 (cm) Volume: 3379.8 (cm3) Weight: 1.36 (kg)
Low Range: High Range:
Accuracy: .10 % Refresh Rate:
Sensor type: solid state
Power consumption: 10.5 - 17 VDC Moving parts: No

Equipment by Requirement Category

```
=====================================================================
Reference: 3.1.1.05    Barometric pressure
      Required Accuracy: 1 mb
      Required Refresh Rate:   15 (min)
=====================================================================

Vaisala                Model: PTB 200A                  System:  00
  Length:      10.0 (cm)  Width:       10.0 (cm)   Height:   7.6 (cm)
  Diameter:     0.0 (cm)  Volume:     760.0 (cm3)  Weight:   1.00 (kg)
  Low Range:  600.0       High Range:  1100.0 mb
  Accuracy:      .20 mb                    Refresh Rate: continuous
  Sensor type: BAROCAP silicon capacitive abs pres sens
  Power consumption:                       Moving parts: No


Vaisala                Model: PA 11A Digital Barometer System:  00
  Length:      7.2 (cm)  Width:       14.4 (cm)   Height:  25.0 (cm)
  Diameter:     0.0 (cm)  Volume:    2592.0 (cm3)  Weight:   1.70 (kg)
  Low Range:  500.0       High Range:  1060.0 mb
  Accuracy:      .20 mb                    Refresh Rate:
  Sensor type: 3 user sel. aneroid capsules & transduce
  Power consumption: 10-28 VDC  Battery AC ada  Moving parts: No


EASI                   Model: EZ420                     System:  00
  Length:     15.0 (cm)  Width:        5.0 (cm)   Height:   7.6 (cm)
  Diameter:     0.0 (cm)  Volume:     570.0 (cm3)  Weight:   1.40 (kg)
  Low Range:  600.0       High Range:  1100.0 mb
  Accuracy:      .25 mb                    Refresh Rate:
  Sensor type: symmetrical var cap ceramic capsule
  Power consumption: 20 - 32 VDC           Moving parts: No


AIR (Atmo Inst Rsch)   Model: DB-1A                     System:  04
  Length:      0.0 (cm)  Width:        0.0 (cm)   Height:   8.9 (cm)
  Diameter:     8.9 (cm)  Volume:     553.7 (cm3)  Weight:    .59 (kg)
  Low Range:  800.0       High Range:  1060.0 mb
  Accuracy:      .30 mb                    Refresh Rate: .1 SEC
  Sensor type: Dual diaphragm pressure sensor
  Power consumption: 11-16 VDC             Moving parts: No


Vaisala                Model: PTB 201A                  System:  00
  Length:      10.0 (cm)  Width:       10.0 (cm)   Height:   7.6 (cm)
  Diameter:     0.0 (cm)  Volume:     760.0 (cm3)  Weight:   1.00 (kg)
  Low Range:  600.0       High Range:  1100.0 mb
  Accuracy:      .30 mb                    Refresh Rate: continuous
  Sensor type: BAROCAP silicon capacitive abs pres sens
  Power consumption:                       Moving parts: No
```

Equipment by Requirement Category

Reference: 3.1.1.05 Barometric pressure
Required Accuracy: 1 mb
Required Refresh Rate: 15 (min)

Vaisala Model: DPA 21 Digital Barometer System: 00
Length: 12.5 (cm) Width: 12.5 (cm) Height: 12.5 (cm)
Diameter: 0.0 (cm) Volume: 156.4 (cm3) Weight: 4.50 (kg)
Low Range: 500.0 High Range: 1050.0 mb
Accuracy: .30 mb Refresh Rate: continuous
Sensor type:
Power consumption: Moving parts: No

Vaisala Model: PA 21 Aviation Baromete System: 00
Length: 13.8 (cm) Width: 13.8 (cm) Height: 36.5 (cm)
Diameter: 0.0 (cm) Volume: 6951.1 (cm3) Weight: 4.50 (kg)
Low Range: 500.0 High Range: 1060.0 mb
Accuracy: .30 mb Refresh Rate:
Sensor type:
Power consumption: 115/230 VAC Moving parts: No

Vaisala Model: PTA 427 Analog Barometer System: 00
Length: 12.7 (cm) Width: 6.6 (cm) Height: 3.0 (cm)
Diameter: 0.0 (cm) Volume: 255.7 (cm3) Weight: .16 (kg)
Low Range: 800.0 High Range: 1060.0 mb
Accuracy: .40 mb Refresh Rate:
Sensor type: BAROCAP silicon capacitive abs pres sens
Power consumption: 11-30 VDC Moving parts: No

Campbell Scientific Model: PTA427 System: 00
Length: 12.7 (cm) Width: 6.6 (cm) Height: 3.0 (cm)
Diameter: 0.0 (cm) Volume: 255.7 (cm3) Weight: .16 (kg)
Low Range: 600.0 High Range: 1060.0 mb
Accuracy: .50 mb Refresh Rate: N/A
Sensor type: silicon cap
Power consumption: <10mA Moving parts: No

AIR (Atmo Inst Rsch) Model: HB-1A/2A/1F System: 00
Length: 3.0 (cm) Width: 9.1 (cm) Height: 14.5 (cm)
Diameter: 0.0 (cm) Volume: 395.9 (cm3) Weight: .28 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .50 mb Refresh Rate:
Sensor type: dual diaphragm pressure sensor
Power consumption: 9 V battery Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.1.1.05 Barometric pressure
Required Accuracy: 1 mb
Required Refresh Rate: 15 (min)

==========

Scientific Sales Model: AIR-HB-1A/2A/1F System: 04
Length: 3.0 (cm) Width: 9.1 (cm) Height: 14.5 (cm)
Diameter: 0.0 (cm) Volume: 395.9 (cm3) Weight: .28 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .50 mb Refresh Rate: continuous
Sensor type: dual diaphragm pressure sensor
Power consumption: 9 V alk battery Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-1B System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .50 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-2A System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 800.0 High Range: 1060.0 mb
Accuracy: .50 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

Handar Model: AWOS Dual Barometers System: 00
Length: 15.0 (cm) Width: 15.0 (cm) Height: 30.0 (cm)
Diameter: 0.0 (cm) Volume: 6750.0 (cm3) Weight: 2.25 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .50 mb Refresh Rate:
Sensor type: Dual diaphr
Power consumption: Moving parts: No

Vaisala Model: PTA 427A Analog Baromete System: 00
Length: 12.7 (cm) Width: 6.6 (cm) Height: 3.0 (cm)
Diameter: 0.0 (cm) Volume: 255.7 (cm3) Weight: .16 (kg)
Low Range: 600.0 High Range: 1060.0 mb
Accuracy: .60 mb Refresh Rate:
Sensor type: BAROCAP silicon capacitive abs pres sens
Power consumption: 11-30 VDC Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.05 Barometric pressure
Required Accuracy: 1 mb
Required Refresh Rate: 15 (min)

AIR (Atmo Inst Rsch) Model: DB-1C System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 0.0 High Range: 1100.0 mb
Accuracy: .60 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-2B System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .70 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-3A System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 800.0 High Range: 1060.0 mb
Accuracy: .70 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

TX Electronics Inc Model: TB-2012 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 14.0 (cm)
Diameter: 7.6 (cm) Volume: 637.1 (cm3) Weight: .79 (kg)
Low Range: 677.0 High Range: 1084.0 mb
Accuracy: .70 mb Refresh Rate:
Sensor type: bellows
Power consumption: 2 V 400-1000 Hz Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-3B System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .80 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.05 Barometric pressure
Required Accuracy: 1 mb
Required Refresh Rate: 15 (min)

Scientific Sales Model: 7105-A Analog Output Bar System: 00
Length: 11.4 (cm) Width: 7.9 (cm) Height: 5.4 (cm)
Diameter: 0.0 (cm) Volume: 486.3 (cm3) Weight: .18 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: .88 mb Refresh Rate: continuous
Sensor type: piezoresistive diaphragm
Power consumption: .18VA Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-2C System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 0.0 High Range: 1100.0 mb
Accuracy: .90 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: DB-3C System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.9 (cm)
Diameter: 8.9 (cm) Volume: 553.7 (cm3) Weight: .59 (kg)
Low Range: 0.0 High Range: 1100.0 mb
Accuracy: 1.00 mb Refresh Rate: .1 SEC
Sensor type: Dual diaphragm pressure sensor
Power consumption: 11-16 VDC Moving parts: No

Qualimetrics Inc Model: 9000 TAMS System: 01
Length: 22.9 (cm) Width: 9.5 (cm) Height: 4.3 (cm)
Diameter: 0.0 (cm) Volume: 935.5 (cm3) Weight: .90 (kg)
Low Range: 610.0 High Range: 1084.0 mb
Accuracy: 1.00 mb Refresh Rate:
Sensor type:
Power consumption: 6-12 AA, DC, Lith bat Moving parts: Yes

Scientific Sales Model: 230-700 Bar. Pres. Senso System: 00
Length: 19.0 (cm) Width: 14.0 (cm) Height: 12.7 (cm)
Diameter: 0.0 (cm) Volume: 3379.8 (cm3) Weight: 1.36 (kg)
Low Range: High Range:
Accuracy: 1.00 mb Refresh Rate:
Sensor type: solid state technology
Power consumption: 10.5 -17 VDC Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.05 Barometric pressure
Required Accuracy: 1 mb
Required Refresh Rate: 15 (min)

EASI Model: EZ430 System: 00
Length: 15.0 (cm) Width: 5.0 (cm) Height: 7.6 (cm)
Diameter: 0.0 (cm) Volume: 570.0 (cm3) Weight: 1.40 (kg)
Low Range: 800.0 High Range: 1100.0 mb
Accuracy: 1.00 % Refresh Rate:
Sensor type: integrated circuit silicon sensor
Power consumption: 12 - 36 VDC Moving parts: No

EASI Model: EZ435 System: 00
Length: 15.0 (cm) Width: 5.0 (cm) Height: 7.6 (cm)
Diameter: 0.0 (cm) Volume: 570.0 (cm3) Weight: 1.40 (kg)
Low Range: 500.0 High Range: 1100.0 mb
Accuracy: 1.00 % Refresh Rate: N/A
Sensor type:
Power consumption: 12 - 36 VDC Moving parts: No

METOCEAN Model: CMOD System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 91.4 (cm)
Diameter: 12.2 (cm) Volume: 10684.6 (cm3) Weight: 12.73 (kg)
Low Range: 900.0 High Range: 1053.0 mb
Accuracy: 1.00 mb Refresh Rate:
Sensor type: ARGOS Drifting buoy (ARGOS)
Power consumption: 5 - 17.6 V battery Moving parts: Yes

Climatronics Model: EWS System: 01
Length: 39.4 (cm) Width: 78.1 (cm) Height: 14.6 (cm)
Diameter: 0.0 (cm) Volume: 44926.2 (cm3) Weight: 20.00 (kg)
Low Range: High Range:
Accuracy: 1.00 mb Refresh Rate: N/A
Sensor type: stack of diaphrams linked to potientomet
Power consumption: Moving parts: Yes

METOCEAN Model: Standard Drifter System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 350.0 (cm)
Diameter: 69.0 (cm) Volume: 1308751.3 (cm3) Weight: 95.00 (kg)
Low Range: 900.0 High Range: 1053.0 mb
Accuracy: 1.00 mb Refresh Rate:
Sensor type: (TIROS/ARGOS)
Power consumption: Alkaline Bat (5-17.6V) Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.1.1.05 Barometric pressure
Required Accuracy: 1 mb
Required Refresh Rate: 15 (min)

==========

MET ONE Model: AutoMet System: 01
Length: 61.0 (cm) Width: 30.0 (cm) Height: 183.0 (cm)
Diameter: 0.0 (cm) Volume: 334890.0 (cm3) Weight: 0.00 (kg)
Low Range: 677.0 High Range: 1084.0 mb
Accuracy: 1.35 mb Refresh Rate: instantenous
Sensor type:
Power consumption: 12 VDC Int Bat Pk Moving parts: Yes

MET ONE Model: AutoMet 25 System: 01
Length: 20.0 (cm) Width: 20.0 (cm) Height: 20.0 (cm)
Diameter: 0.0 (cm) Volume: 8000.0 (cm3) Weight: 2.00 (kg)
Low Range: 880.0 High Range: 1084.0 mb
Accuracy: 1.40 mb Refresh Rate:
Sensor type:
Power consumption: 12 VDC, battery, solar Moving parts: Yes

Climatronics Model: 101448 System: 00
Length: 3.8 (cm) Width: 7.6 (cm) Height: 5.1 (cm)
Diameter: 0.0 (cm) Volume: 147.3 (cm3) Weight: 0.00 (kg)
Low Range: 600.0 High Range: 1100.0 mb
Accuracy: 1.50 mb Refresh Rate: N/A
Sensor type: piezoresistive
Power consumption: 12 VDC Moving parts: No

METOCEAN Model: CALIB System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 91.4 (cm)
Diameter: 12.4 (cm) Volume: 11037.7 (cm3) Weight: 8.00 (kg)
Low Range: 900.0 High Range: 1053.0 mb
Accuracy: 1.50 mb Refresh Rate:
Sensor type: Data sent to ARGOS
Power consumption: 5 - 17.6 V battery Moving parts: No

METOCEAN Model: Ice Beacon System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 31.0 (cm)
Diameter: 54.0 (cm) Volume: 70997.0 (cm3) Weight: 20.00 (kg)
Low Range: 900.0 High Range: 1053.0 mb
Accuracy: 1.50 mb Refresh Rate:
Sensor type: Data sent to ARGOS
Power consumption: 5 - 17.6 V battery Moving parts: Yes

Equipment by Requirement Category

Reference: 3.1.1.05 Barometric pressure
Required Accuracy: 1 mb
Required Refresh Rate: 15 (min)

Davis Instruments Model: Perception II System: 01
Length: 13.3 (cm) Width: 14.9 (cm) Height: 7.7 (cm)
Diameter: 0.0 (cm) Volume: 1525.9 (cm3) Weight: .50 (kg)
Low Range: 880.0 High Range: 1080.0 mb
Accuracy: 1.70 mb Refresh Rate: N/A
Sensor type:
Power consumption: AC with battery backup Moving parts: No

Davis Instruments Model: Weather Monitor II System: 01
Length: 13.3 (cm) Width: 14.9 (cm) Height: 7.7 (cm)
Diameter: 0.0 (cm) Volume: 1525.9 (cm3) Weight: .50 (kg)
Low Range: 880.0 High Range: 1080.0 mb
Accuracy: 1.70 mb Refresh Rate: N/A
Sensor type:
Power consumption: AC with battery backup Moving parts: Yes

Scientific Sales Model: 9000 Mobile-Met System: 01
Length: 33.0 (cm) Width: 25.4 (cm) Height: 15.2 (cm)
Diameter: 0.0 (cm) Volume: 12740.6 (cm3) Weight: 3.60 (kg)
Low Range: 880.0 High Range: 1118.0 mb
Accuracy: 1.70 mb Refresh Rate:
Sensor type:
Power consumption: 6-12 AA, 12-18 VDC Moving parts: Yes

Weather Port Model: Weather Report WR-25/C System: 01
Length: 31.0 (cm) Width: 15.2 (cm) Height: 8.9 (cm)
Diameter: 0.0 (cm) Volume: 4193.7 (cm3) Weight: 22.50 (kg)
Low Range: 949.0 High Range: 1084.0 mb
Accuracy: 2.00 % Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

Weather Port Model: Weather Report WR-25/S System: 01
Length: 31.0 (cm) Width: 15.2 (cm) Height: 8.9 (cm)
Diameter: 0.0 (cm) Volume: 4193.7 (cm3) Weight: 22.50 (kg)
Low Range: 949.0 High Range: 1084.0 mb
Accuracy: 2.00 % Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

Equipment by Requirement Category

```
==========================================================================
Reference: 3.1.1.05    Barometric pressure
      Required Accuracy: 1 mb
      Required Refresh Rate:   15 (min)
==========================================================================

Scientific Sales        Model: WST7000 Weather Station  System:  01
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  40.0 (cm)
  Diameter:     10.5 (cm)  Volume:    3463.6 (cm3)  Weight:   2.20 (kg)
  Low Range:   600.0       High Range:  1100.0 mb
  Accuracy:      3.00 mb                    Refresh Rate: 10 msec
  Sensor type:
  Power consumption: 24 VDC                     Moving parts: No


MesoTech Internation   Model: NBC 5056 Auto WX Station System:  01
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  55.0 (cm)
  Diameter:      8.0 (cm)  Volume:    2764.6 (cm3)  Weight:   3.20 (kg)
  Low Range:   600.0       High Range:  1100.0 mb
  Accuracy:      3.00 mb                    Refresh Rate: 10 msec
  Sensor type:
  Power consumption: 24 VDC opt power supply    Moving parts: No


NovaLynx                Model: TFV4056                   System:  01
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  32.0 (cm)
  Diameter:     10.5 (cm)  Volume:    2770.9 (cm3)  Weight:   2.20 (kg)
  Low Range:   600.0       High Range:  1100.0 mb
  Accuracy:      5.00 mb                    Refresh Rate: 10 msec
  Sensor type:
  Power consumption: 24 VDC                     Moving parts: No

--------------------------------------------------------------------------
```

Equipment by Requirement Category

Reference: 3.1.1.07a Cloud base height
Required Accuracy: 50 m (SFC - 1000 ft)
Required Refresh Rate: 15 (min)

Qualimetrics Inc Model: 8329 Laser Ceilometer System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 135.0 (cm)
Diameter: 48.3 (cm) Volume: 247354.0 (cm3) Weight: 61.30 (kg)
Low Range: 30.0 High Range: 12500.0 ft
Accuracy: Refresh Rate: 15-30 sec
Sensor type: gallium arsenide diode
Power consumption: 1800 VA Moving parts: No

Vaisala Model: CT 12K System: 01
Length: 73.9 (cm) Width: 57.9 (cm) Height: 41.9 (cm)
Diameter: 0.0 (cm) Volume: 179282.1 (cm3) Weight: 60.00 (kg)
Low Range: 0.0 High Range: 12500.0 ft
Accuracy: 6.10 m Refresh Rate: continuous
Sensor type: laser
Power consumption: 115/230/240 VAC Moving parts: No

Handar Model: 450 System: 01
Length: 37.5 (cm) Width: 37.5 (cm) Height: 147.5 (cm)
Diameter: 0.0 (cm) Volume: 207421.9 (cm3) Weight: 39.54 (kg)
Low Range: 0.0 High Range: 12000.0 ft
Accuracy: 15.00 m Refresh Rate: 30 SEC
Sensor type:
Power consumption: Max 700W 115/230V Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.1.1.07b Cloud base height
Required Accuracy: 5% (>1000 ft)
Required Refresh Rate: 15 (min)

==========

Qualimetrics Inc Model: 8329 Laser Ceilometer System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 135.0 (cm)
Diameter: 48.3 (cm) Volume: 247354.0 (cm3) Weight: 61.30 (kg)
Low Range: 30.0 High Range: 12500.0 ft
Accuracy: Refresh Rate: 15-30 sec
Sensor type: gallium arsenide diode
Power consumption: 1800 VA Moving parts: No

Vaisala Model: CT 12K System: 02
Length: 73.9 (cm) Width: 57.9 (cm) Height: 41.9 (cm)
Diameter: 0.0 (cm) Volume: 179282.1 (cm3) Weight: 60.00 (kg)
Low Range: 0.0 High Range: 12500.0 ft
Accuracy: 6.10 m Refresh Rate: continuous
Sensor type: laser
Power consumption: 115/230/240 VAC Moving parts: No

Handar Model: 450 System: 02
Length: 37.5 (cm) Width: 37.5 (cm) Height: 147.5 (cm)
Diameter: 0.0 (cm) Volume: 207421.9 (cm3) Weight: 39.54 (kg)
Low Range: 0.0 High Range: 12000.0 ft
Accuracy: 15.00 m Refresh Rate: 30 SEC
Sensor type:
Power consumption: Max 700W 115/230V Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.18 Humidity, relative
Required Accuracy: 5%
Required Refresh Rate: 15 (min)

Climatronics Model: 100098 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 7.9 (cm)
Diameter: 1.0 (cm) Volume: 5.8 (cm3) Weight: 0.00 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: Refresh Rate: 3 min
Sensor type: silicon, piezoresistive strain gage
Power consumption: Max 0.5 VDC Moving parts: No

Climatronics Model: 101943 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 19.5 (cm)
Diameter: 1.9 (cm) Volume: 52.4 (cm3) Weight: 0.00 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: Refresh Rate: 15 sec
Sensor type: HUMICAP Capactive
Power consumption: 12 VDC Moving parts: No

Climatronics Model: 101812 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 19.5 (cm)
Diameter: 2.5 (cm) Volume: 95.7 (cm3) Weight: 0.00 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: Refresh Rate: 10 sec
Sensor type: Capactive
Power consumption: 8-35 VDC Moving parts: No

Scientific Sales Model: Sensaire System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 5.0 (cm)
Diameter: 10.0 (cm) Volume: 393.0 (cm3) Weight: .45 (kg)
Low Range: 20.0 High Range: 90.0 % RH
Accuracy: Refresh Rate:
Sensor type: King Hygrometer Spring w/motion sensing
Power consumption: AC adapter Moving parts: Yes

Scientific Sales Model: WeatherMax System: 02
Length: 25.0 (cm) Width: 23.0 (cm) Height: 9.0 (cm)
Diameter: 0.0 (cm) Volume: 5175.0 (cm3) Weight: 2.00 (kg)
Low Range: 20.0 High Range: 100.0 % RH
Accuracy: Refresh Rate:
Sensor type:
Power consumption: 12 VDC Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.1.1.18 Humidity, relative
Required Accuracy: 0.0500000000
Required Refresh Rate: 15 (min)

==========

Scientific Sales Model: 9000 Mobile-Met System: 02
Length: 33.0 (cm) Width: 25.4 (cm) Height: 15.2 (cm)
Diameter: 0.0 (cm) Volume: 12740.6 (cm3) Weight: 3.60 (kg)
Low Range: 5.0 High Range: 100.0 % RH
Accuracy: Refresh Rate:
Sensor type:
Power consumption: 6-12 AA, 12-18 VDC Moving parts: Yes

NovaLynx Model: 2046RH System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 23.5 (cm)
Diameter: 1.9 (cm) Volume: 66.6 (cm3) Weight: .28 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 1.00 % Refresh Rate: 15 sec
Sensor type:
Power consumption: 12 VDC Moving parts: No

NovaLynx Model: Qualimetrics 2046 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 23.5 (cm)
Diameter: 1.9 (cm) Volume: 66.6 (cm3) Weight: .28 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 1.00 % Refresh Rate: 15 sec
Sensor type:
Power consumption: 12 VDC Moving parts: No

NovaLynx Model: Qualimetrics 230-504 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 23.5 (cm)
Diameter: 1.9 (cm) Volume: 66.6 (cm3) Weight: .28 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 1.00 % Refresh Rate: 15 sec
Sensor type: thin film capacitor
Power consumption: 7-35 VDC Moving parts: No

EASI Model: EZ325 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 0.0 (cm3) Weight: 0.00 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 2.00 % Refresh Rate:
Sensor type: dewpoint transducer
Power consumption: 24 - 36 VDC Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.18 Humidity, relative
Required Accuracy: 0.0500000000
Required Refresh Rate: 15 (min)

Scientific Sales Model: 41372/43372 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 7.6 (cm)
Diameter: 2.5 (cm) Volume: 38.5 (cm3) Weight: .10 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 2.00 % Refresh Rate: 15 sec
Sensor type:
Power consumption: 8-24 VDC / 9mA Moving parts: No

Handar Model: 435A System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 24.6 (cm)
Diameter: 1.9 (cm) Volume: 69.7 (cm3) Weight: .13 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 2.00 % Refresh Rate: N/A
Sensor type: humidity
Power consumption: 10 - 15 VDC Moving parts: No

AIR (Atmo Inst Rsch) Model: HA-1P System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.0 (cm)
Diameter: 1.9 (cm) Volume: 85.1 (cm3) Weight: .14 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 2.00 % Refresh Rate: 0.5 SEC
Sensor type: HUMAIR capacitance polymer
Power consumption: 5mA @ 7 Volts Moving parts: No

Vaisala Model: HMP 35D System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.0 (cm)
Diameter: 2.5 (cm) Volume: 147.0 (cm3) Weight: .17 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 2.00 % Refresh Rate: 15 sec
Sensor type: HUMICAP H-sensor
Power consumption: 7-35 VDC Moving parts: No

Young Meteor. Inst Model: 41372/43372 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 16.5 (cm)
Diameter: 2.5 (cm) Volume: 81.0 (cm3) Weight: .20 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 2.00 % Refresh Rate: 15 sec
Sensor type: Vaisala Intercap
Power consumption: 8-24 VDC / 9mA Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.1.1.18 Humidity, relative
Required Accuracy: 0.0500000000
Required Refresh Rate: 15 (min)

==========

Scientific Sales Model: 5120-D/E and 5129 D/E System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 21.6 (cm)
Diameter: 1.9 (cm) Volume: 61.2 (cm3) Weight: .23 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 2.00 % Refresh Rate: 1 sec
Sensor type: thin film capacitor
Power consumption: 3.6 VDC reg, 15 mW Moving parts: No

NovaLynx Model: HM34 System: 01
Length: 16.0 (cm) Width: 5.7 (cm) Height: 2.7 (cm)
Diameter: 0.0 (cm) Volume: 246.2 (cm3) Weight: .23 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 2.00 % Refresh Rate: 15 sec
Sensor type: HUMICAP H-Sensor
Power consumption: 9 Volt battery Moving parts: No

VIZ (ZEEMET) Model: MARK II MICROSONDE System: 01
Length: 14.4 (cm) Width: 10.2 (cm) Height: 19.3 (cm)
Diameter: 0.0 (cm) Volume: 2834.8 (cm3) Weight: .30 (kg)
Low Range: 5.0 High Range: 100.0 % RH
Accuracy: 2.00 % Refresh Rate: 1 SEC
Sensor type: Carbon type
Power consumption: 12 V water activated bat Moving parts: No

Handar Model: 435C System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 19.6 (cm)
Diameter: 2.5 (cm) Volume: 99.3 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 2.00 % Refresh Rate: N/A
Sensor type: hygroscopic
Power consumption: 8 to 35 VDC,10mA Moving parts: No

Campbell Scientific Model: Vaisala HMP35C System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 25.4 (cm)
Diameter: 2.5 (cm) Volume: 129.0 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 100.0 %RH
Accuracy: 2.00 % Refresh Rate: N/A
Sensor type: Cap Polymer H Chip
Power consumption: 12VDC Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.18 Humidity, relative
Required Accuracy: 0.0500000000
Required Refresh Rate: 15 (min)

EASI Model: EZ300/310/315 System: 00
Length: 5.0 (cm) Width: 7.6 (cm) Height: 12.7 (cm)
Diameter: 0.0 (cm) Volume: 483.0 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 2.00 % Refresh Rate: N/A
Sensor type: macro-resistive polymer humidity sensor
Power consumption: 12 - 36 VDC Moving parts: No

TX Electronics Inc Model: TH-2013 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 22.9 (cm)
Diameter: 8.3 (cm) Volume: 1239.0 (cm3) Weight: 2.30 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 2.00 % Refresh Rate:
Sensor type: hydroscopiic inorganic sensing element
Power consumption: 2 V 400 - 1000 Hz Moving parts: No

Scientific Sales Model: 5191 System: 01
Length: 2.5 (cm) Width: 5.0 (cm) Height: 7.6 (cm)
Diameter: 0.0 (cm) Volume: 950.0 (cm3) Weight: .20 (kg)
Low Range: 10.0 High Range: 95.0 % RH
Accuracy: 3.00 % Refresh Rate:
Sensor type:
Power consumption: 9 V battery Moving parts: No

AIR (Atmo Inst Rsch) Model: IS-4A series System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 0.0 (cm3) Weight: .22 (kg)
Low Range: 5.0 High Range: 100.0 % RH
Accuracy: 3.00 % Refresh Rate:
Sensor type: Carbon Hygristor
Power consumption: 80-200 VAC, 12V battery Moving parts: No

Qualimetrics Inc Model: 9000 TAMS System: 02
Length: 22.9 (cm) Width: 9.5 (cm) Height: 4.3 (cm)
Diameter: 0.0 (cm) Volume: 935.5 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 3.00 % Refresh Rate:
Sensor type:
Power consumption: 6-12 AA, DC, Lith bat Moving parts: Yes

Equipment by Requirement Category

```
==========================================================================
Reference: 3.1.1.18    Humidity, relative
      Required Accuracy: 0.0500000000
      Required Refresh Rate:   15 (min)
==========================================================================

TX Electronics Inc      Model: TH-2013V                    System:  00
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  22.9 (cm)
  Diameter:      8.3 (cm)  Volume:    1239.0 (cm3)  Weight:   1.59 (kg)
  Low Range:     0.0       High Range:   100.0 % RH
  Accuracy:      3.00 %                     Refresh Rate:
  Sensor type:
  Power consumption: 7 - 28 V DC                Moving parts: No


NovaLynx                Model: TFV4056                     System:  02
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  32.0 (cm)
  Diameter:     10.5 (cm)  Volume:    2770.9 (cm3)  Weight:   2.20 (kg)
  Low Range:    10.0       High Range:   100.0 % RH
  Accuracy:      3.00 %                     Refresh Rate: 10 msec
  Sensor type:
  Power consumption: 24 VDC                     Moving parts: No


Scientific Sales        Model: WST7000 Weather Station  System:  02
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  40.0 (cm)
  Diameter:     10.5 (cm)  Volume:    3463.6 (cm3)  Weight:   2.20 (kg)
  Low Range:    10.0       High Range:   100.0 % RH
  Accuracy:      3.00 %                     Refresh Rate: 10 msec
  Sensor type:
  Power consumption: 24 VDC                     Moving parts: No


TX Wx Inst Inc          Model: Weather Report System    System:  01
  Length:       31.0 (cm)  Width:       15.2 (cm)   Height:   8.9 (cm)
  Diameter:      0.0 (cm)  Volume:    4193.7 (cm3)  Weight:  22.50 (kg)
  Low Range:     0.0       High Range:   100.0 % RH
  Accuracy:      3.00 %                     Refresh Rate:
  Sensor type:
  Power consumption: RS 232 adapter             Moving parts: Yes


Weather Port            Model: Weather Report WR-25/S   System:  02
  Length:       31.0 (cm)  Width:       15.2 (cm)   Height:   8.9 (cm)
  Diameter:      0.0 (cm)  Volume:    4193.7 (cm3)  Weight:  22.50 (kg)
  Low Range:     0.0       High Range:   100.0 % RH
  Accuracy:      3.00 %                     Refresh Rate:
  Sensor type:
  Power consumption:                            Moving parts: No
```

Equipment by Requirement Category

Reference: 3.1.1.18 Humidity, relative
Required Accuracy: 5%
Required Refresh Rate: 15 (min)

Climatronics Model: TACMET System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 32.4 (cm)
Diameter: 10.2 (cm) Volume: 2647.5 (cm3) Weight: .77 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 4.00 % Refresh Rate: N/A
Sensor type: IREMBAS COTS Wx Module
Power consumption: 12 VDC @ 10mA Moving parts: Yes

Climatronics Model: METRAC System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 83.3 (cm)
Diameter: 10.0 (cm) Volume: 6542.4 (cm3) Weight: 5.00 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 4.00 % Refresh Rate: N/A
Sensor type: IREMBAS COTS Wx Module
Power consumption: 12 V or rechargeable bat. Moving parts: Yes

Davis Instruments Model: Weather Monitor II System: 02
Length: 13.3 (cm) Width: 14.9 (cm) Height: 7.7 (cm)
Diameter: 0.0 (cm) Volume: 1525.9 (cm3) Weight: .50 (kg)
Low Range: 20.0 High Range: 100.0 %
Accuracy: 5.00 % Refresh Rate: N/A
Sensor type:
Power consumption: AC with battery backup Moving parts: Yes

Climatronics Model: EWS System: 02
Length: 39.4 (cm) Width: 78.1 (cm) Height: 14.6 (cm)
Diameter: 0.0 (cm) Volume: 44926.2 (cm3) Weight: 20.00 (kg)
Low Range: 0.0 High Range: 100.0 % RH
Accuracy: 5.00 % Refresh Rate: N/A
Sensor type:
Power consumption: AC/DC Moving parts: Yes

Equipment by Requirement Category

Reference: 3.1.1.22 Illumination
Required Accuracy: .001 ftcndls
Required Refresh Rate: 30 (min)

Li-Cor Model: LI-210SA Photometric Sen System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 2.5 (cm)
Diameter: 2.4 (cm) Volume: 11.3 (cm3) Weight: .03 (kg)
Low Range: High Range:
Accuracy: Refresh Rate: 10 micro sec
Sensor type: Photometric sensor
Power consumption: Moving parts: No

Li-Cor Model: LI-1800/12S System: 01
Length: 16.3 (cm) Width: 20.1 (cm) Height: 36.0 (cm)
Diameter: 0.0 (cm) Volume: 11794.7 (cm3) Weight: 6.40 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type:
Power consumption: 6V NiCad bat Moving parts: No

Li-Cor Model: LI-1800UW System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 28.0 (cm)
Diameter: 32.0 (cm) Volume: 22519.0 (cm3) Weight: 25.00 (kg)
Low Range: 0.0 High Range: 200.0 m
Accuracy: Refresh Rate:
Sensor type:
Power consumption: 6V NiCad bat Moving parts: No

Scientific Sales Model: 3311 System: 00
Length: 7.0 (cm) Width: 16.3 (cm) Height: 3.0 (cm)
Diameter: 0.0 (cm) Volume: 342.3 (cm3) Weight: .25 (kg)
Low Range: 0.0 High Range: 5000.0 ftcndls
Accuracy: 5.00 % Refresh Rate:
Sensor type: Selenium photocell
Power consumption: 9 VDC battery Moving parts: No

Equipment by Requirement Category

```
==========================================================================
Reference: 3.1.1.27    Lightning/thunderstorms
      Required Accuracy: 0.5 mi of location
      Required Refresh Rate:    5 (min)
==========================================================================

Handar                    Model: 420A                        System:  00
  Length:      0.0 (cm)  Width:        0.0 (cm)   Height: 168.0 (cm)
  Diameter:   34.3 (cm)  Volume:  155234.6 (cm3)  Weight:  36.00 (kg)
  Low Range:   0.0       High Range:   100.0 nm
  Accuracy:   10.00 %                     Refresh Rate:
  Sensor type: CMOS components
  Power consumption: 105 -120 VAC              Moving parts: No


Qualimetrics Inc          Model: ESID Elec Storm ID Dev   System:  00
  Length:    666.0 (cm)  Width:       25.4 (cm)   Height:  30.5 (cm)
  Diameter:    0.0 (cm)  Volume:  515950.2 (cm3)  Weight:   0.00 (kg)
  Low Range:   0.0       High Range:    25.0 miles
  Accuracy:  100.00 %                     Refresh Rate:
  Sensor type:
  Power consumption: 12 VDC                    Moving parts: No

--------------------------------------------------------------------------


==========================================================================
Reference: 3.1.1.28a   Precipitation, accumulation, liquid
      Required Accuracy: 0.25 cm (liquid); 1.25 cm (frozen)
      Required Refresh Rate:   15 (min)
==========================================================================

Vaisala                   Model: DRD 11A                     System:  00
  Length:     11.0 (cm)  Width:        8.0 (cm)   Height:  17.5 (cm)
  Diameter:    0.0 (cm)  Volume:    1540.0 (cm3)  Weight:    .45 (kg)
  Low Range:             High Range:
  Accuracy:                               Refresh Rate:
  Sensor type: Capactive prin thick layer sensor RAINCA
  Power consumption: 12 VDC                    Moving parts: Yes


NovaLynx                  Model: 260-322 All season Prec. System:  00
  Length:      0.0 (cm)  Width:        0.0 (cm)   Height: 185.4 (cm)
  Diameter:   30.5 (cm)  Volume:  135456.6 (cm3)  Weight:  12.70 (kg)
  Low Range:   0.0       High Range:    55.0 in
  Accuracy:                               Refresh Rate:
  Sensor type: stainless steel presure transducer
  Power consumption: 12 VDC @ 8 mA             Moving parts: No
```

Equipment by Requirement Category

==========

Reference: 3.1.1.28a Precipitation, accumulation, liquid
Required Accuracy: 0.25 cm (liquid); 1.25 cm (frozen)
Required Refresh Rate: 15 (min)

==========

Scientific Sales Model: 260-322 All season Prec. System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 185.4 (cm)
Diameter: 30.5 (cm) Volume: 135456.6 (cm3) Weight: 12.70 (kg)
Low Range: 0.0 High Range: 55.0 in
Accuracy: Refresh Rate:
Sensor type: stainless steel presure transducer
Power consumption: 12 VDC @ 8 mA Moving parts: No

Weather Port Model: Weather Report WR-25/S System: 03
Length: 31.0 (cm) Width: 15.2 (cm) Height: 8.9 (cm)
Diameter: 0.0 (cm) Volume: 4193.7 (cm3) Weight: 22.50 (kg)
Low Range: 0.0 High Range: 999.0 in
Accuracy: Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

Davis Instruments Model: Weather Wizard III System: 01
Length: 13.3 (cm) Width: 14.9 (cm) Height: 7.7 (cm)
Diameter: 0.0 (cm) Volume: 1525.9 (cm3) Weight: .50 (kg)
Low Range: .0 High Range: 24.0 cm
Accuracy: .02 cm Refresh Rate: N/A
Sensor type: tipping bucket
Power consumption: AC with battery backup Moving parts: Yes

Scientific Sales Model: 6731 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 65.0 (cm)
Diameter: 10.8 (cm) Volume: 5954.6 (cm3) Weight: 2.50 (kg)
Low Range: 0.0 High Range: 50.0 mm
Accuracy: .10 cm Refresh Rate: 30 sec
Sensor type: capacitance probe
Power consumption: 8-30 VDC Moving parts: No

Young Meteor. Inst Model: 50202 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 65.0 (cm)
Diameter: 14.0 (cm) Volume: 10006.0 (cm3) Weight: 2.50 (kg)
Low Range: 0.0 High Range: 50.0 mm
Accuracy: .10 cm Refresh Rate: 30 s drain tim
Sensor type: capacitance probe
Power consumption: 8 - 30 VDC Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.1.1.28a Precipitation, accumulation, liquid
Required Accuracy: 0.25 cm (liquid); 1.25 cm (frozen)
Required Refresh Rate: 15 (min)

==========

Scientific Sales Model: 6021 B System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 44.5 (cm)
Diameter: 21.0 (cm) Volume: 15413.1 (cm3) Weight: 3.60 (kg)
Low Range: High Range:
Accuracy: .50 % Refresh Rate: 1 tip/ 0.1 mm
Sensor type: tipping bucket
Power consumption: 115 VAC, 60 Hz Moving parts: Yes

Scientific Sales Model: 6021 D System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 44.5 (cm)
Diameter: 21.0 (cm) Volume: 15413.1 (cm3) Weight: 3.60 (kg)
Low Range: High Range:
Accuracy: .50 % Refresh Rate: 1 tip/0.1 mm
Sensor type: tipping bucket
Power consumption: 230 VAC, 60 Hz Moving parts: Yes

Scientific Sales Model: Qualimetrics 6011 B System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 44.5 (cm)
Diameter: 21.0 (cm) Volume: 15413.1 (cm3) Weight: 3.60 (kg)
Low Range: High Range:
Accuracy: .50 % Refresh Rate: 1 tip/ 0.1 mm
Sensor type: tipping bucket
Power consumption: Moving parts: Yes

Scientific Sales Model: 6028 B System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 45.7 (cm)
Diameter: 31.8 (cm) Volume: 36296.2 (cm3) Weight: 7.30 (kg)
Low Range: High Range:
Accuracy: .50 % Refresh Rate: 1 tip/0.25 mm
Sensor type: tipping bucket
Power consumption: 115 VAC, 60 Hz Moving parts: Yes

Scientific Sales Model: 6028 D System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 45.7 (cm)
Diameter: 31.8 (cm) Volume: 36296.2 (cm3) Weight: 7.30 (kg)
Low Range: High Range:
Accuracy: .50 % Refresh Rate: 1 tip/0.25 mm
Sensor type: tipping bucket
Power consumption: 230 VAC, 60 Hz Moving parts: Yes

Equipment by Requirement Category

```
==========================================================================
Reference: 3.1.1.28a   Precipitation, accumulation, liquid
      Required Accuracy: 0.25 cm (liquid); 1.25 cm (frozen)
      Required Refresh Rate:   15 (min)
==========================================================================

Scientific Sales       Model: Qualimetrics 6018 B      System:  00
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  45.7 (cm)
  Diameter:     31.8 (cm)  Volume:   36296.2 (cm3)  Weight:   7.30 (kg)
  Low Range:               High Range:
  Accuracy:       .50 %                    Refresh Rate: 1 tip/ 0.1 mm
  Sensor type: tipping bucket
  Power consumption:                          Moving parts: Yes


NovaLynx               Model: 6041-B Rain & Snow Gauge System:  01
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  82.3 (cm)
  Diameter:     27.3 (cm)  Volume:   48174.4 (cm3)  Weight:  10.20 (kg)
  Low Range:               High Range:
  Accuracy:       .50 %                    Refresh Rate: 1  tip/ 1 mm
  Sensor type: tipping bucket
  Power consumption: catalytic propane burner   Moving parts: Yes


Climatronics           Model: 100608 (6" Tip Bucket)   System:  00
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   1.0 (cm)
  Diameter:      0.0 (cm)  Volume:       0.0 (cm3)  Weight:   0.00 (kg)
  Low Range:               High Range:
  Accuracy:      1.00 %                   Refresh Rate: 1 per .1mm
  Sensor type: tipping bucket (6 in)
  Power consumption: None without heat          Moving parts: Yes


Scientific Sales       Model: EZ200                    System:  00
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  30.0 (cm)
  Diameter:     10.0 (cm)  Volume:    2432.0 (cm3)  Weight:   1.00 (kg)
  Low Range:               High Range:
  Accuracy:      1.00 %                   Refresh Rate:
  Sensor type: tipping bucket
  Power consumption:                          Moving parts: Yes


TX Electronics Inc     Model: TE525                    System:  00
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  25.7 (cm)
  Diameter:     15.4 (cm)  Volume:    4787.0 (cm3)  Weight:   1.13 (kg)
  Low Range:               High Range:
  Accuracy:      1.00 %                   Refresh Rate: .01" of rain
  Sensor type: tipping bucket
  Power consumption:                          Moving parts: Yes
```

Equipment by Requirement Category

Reference: 3.1.1.28a Precipitation, accumulation, liquid
Required Accuracy: 0.25 cm (liquid); 1.25 cm (frozen)
Required Refresh Rate: 15 (min)

TX Electronics Inc Model: TR-525-1LC System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 25.7 (cm)
Diameter: 15.4 (cm) Volume: 4787.0 (cm3) Weight: 1.13 (kg)
Low Range: High Range:
Accuracy: 1.00 % Refresh Rate: .01" of rain
Sensor type: tipping bucket
Power consumption: Battery (2 N type) Moving parts: Yes

Campbell Scientific Model: TE525 Texas Electronic System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 25.7 (cm)
Diameter: 15.4 (cm) Volume: 4787.0 (cm3) Weight: 1.14 (kg)
Low Range: .0 High Range: 24.0 cm
Accuracy: 1.00 % Refresh Rate: .02 cm of rain
Sensor type: tipping bucket
Power consumption: Supplied by data logger Moving parts: Yes

Campbell Scientific Model: TE525MM Texas Electronic System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 29.2 (cm)
Diameter: 24.5 (cm) Volume: 13826.9 (cm3) Weight: 1.22 (kg)
Low Range: .0 High Range: 29.0 cm
Accuracy: 1.00 % Refresh Rate: .01 cm of rain
Sensor type: tipping bucket
Power consumption: Supplied by data logger Moving parts: Yes

Scientific Sales Model: 260-2501 MM System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 38.1 (cm)
Diameter: 20.3 (cm) Volume: 12331.3 (cm3) Weight: 2.70 (kg)
Low Range: High Range:
Accuracy: 1.00 % Refresh Rate: 1 tip/ 1 mm
Sensor type: tipping bucket
Power consumption: Moving parts: Yes

Scientific Sales Model: 260-2500 System: 00
Length: 20.3 (cm) Width: 43.2 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 877.0 (cm3) Weight: 3.20 (kg)
Low Range: High Range:
Accuracy: 1.00 % Refresh Rate: 1 tip/.25 mm
Sensor type: tipping bucket
Power consumption: Moving parts: Yes

Equipment by Requirement Category

Reference: 3.1.1.28a Precipitation, accumulation, liquid
Required Accuracy: 0.25 cm (liquid); 1.25 cm (frozen)
Required Refresh Rate: 15 (min)

EASI Model: EZ200 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 45.2 (cm)
Diameter: 20.3 (cm) Volume: 14629.2 (cm3) Weight: 3.60 (kg)
Low Range: 0.0 High Range: 36.0 in/hr
Accuracy: 1.00 % Refresh Rate: 1 per .2mm
Sensor type: tipping bucket
Power consumption: Moving parts: Yes

TX Electronics Inc Model: TR-6118 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 43.2 (cm)
Diameter: 26.2 (cm) Volume: 23290.4 (cm3) Weight: 4.54 (kg)
Low Range: High Range:
Accuracy: 1.00 % Refresh Rate: .01" of rain
Sensor type: tipping bucket
Power consumption: 12 V AC or DC Moving parts: Yes

Scientific Sales Model: 260-2500-12 System: 00
Length: 30.5 (cm) Width: 50.8 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 1549.4 (cm3) Weight: 6.40 (kg)
Low Range: High Range:
Accuracy: 1.00 % Refresh Rate: 1 tip/.25 mm
Sensor type: tipping bucket
Power consumption: Moving parts: Yes

Climatronics Model: 100097 (8" Tip Bucket) System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 46.3 (cm)
Diameter: 20.3 (cm) Volume: 14985.2 (cm3) Weight: 11.40 (kg)
Low Range: High Range:
Accuracy: 1.00 % Refresh Rate: 1 per .1mm
Sensor type: tipping bucket (8 in)
Power consumption: None without heat Moving parts: Yes

Climatronics Model: EWS System: 03
Length: 39.4 (cm) Width: 78.1 (cm) Height: 14.6 (cm)
Diameter: 0.0 (cm) Volume: 44926.2 (cm3) Weight: 20.00 (kg)
Low Range: High Range:
Accuracy: 1.00 % Refresh Rate: N/A
Sensor type: tipping bucket
Power consumption: AC/DC Moving parts: Yes

Equipment by Requirement Category

Reference: 3.1.1.28a Precipitation, accumulation, liquid
Required Accuracy: 0.25 cm (liquid); 1.25 cm (frozen)
Required Refresh Rate: 15 (min)

NovaLynx Model: 5050P System: 00
Length: 12.7 (cm) Width: 12.7 (cm) Height: 12.7 (cm)
Diameter: 0.0 (cm) Volume: 2048.4 (cm3) Weight: .45 (kg)
Low Range: High Range:
Accuracy: 3.00 % Refresh Rate:
Sensor type: tipping bucket
Power consumption: Moving parts: Yes

Handar Model: 444A/C System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 43.1 (cm)
Diameter: 20.0 (cm) Volume: 13540.3 (cm3) Weight: 3.90 (kg)
Low Range: High Range:
Accuracy: 3.00 % Refresh Rate:
Sensor type: tipping bucket
Power consumption: 120 VAC,50/60Hz Moving parts: Yes

Handar Model: 444B System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 61.0 (cm)
Diameter: 30.5 (cm) Volume: 44567.7 (cm3) Weight: 6.00 (kg)
Low Range: High Range:
Accuracy: 3.00 % Refresh Rate:
Sensor type: tipping bucket
Power consumption: Moving parts: Yes

Scientific Sales Model: 260-200 Rain Gauge System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 38.1 (cm)
Diameter: 20.3 (cm) Volume: 12331.3 (cm3) Weight: 2.70 (kg)
Low Range: High Range:
Accuracy: 5.00 % Refresh Rate: 1 tip/ 1 mm
Sensor type: tipping bucket
Power consumption: Moving parts: Yes

NovaLynx Model: 2501 Rain Gauge System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 38.1 (cm)
Diameter: 20.3 (cm) Volume: 12331.3 (cm3) Weight: 2.72 (kg)
Low Range: High Range:
Accuracy: 5.00 % Refresh Rate: 1 tip/.001 in
Sensor type: tipping bucket
Power consumption: Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.28a Precipitation, accumulation, liquid
Required Accuracy: 0.25 cm (liquid); 1.25 cm (frozen)
Required Refresh Rate: 15 (min)

==========

Surface Systems Inc Model: WIVIS SCAN RWIS System: 01
Length: 71.0 (cm) Width: 12.7 (cm) Height: 28.0 (cm)
Diameter: 0.0 (cm) Volume: 25248.0 (cm3) Weight: 15.00 (kg)
Low Range: .0 High Range: 200.0 in/hr
Accuracy: 10.00 % Refresh Rate: 1 per minute
Sensor type: WIVIS
Power consumption: 115 VAC, 48-68 Hz Moving parts: No

==========

Reference: 3.1.1.28b Precipitation, accumulation, frozen
Required Accuracy: 0.25 cm (liquid); 1.25 cm (frozen)
Required Refresh Rate: 15 (min)

==========

NovaLynx Model: 6041-B Rain & Snow Gauge System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 82.3 (cm)
Diameter: 27.3 (cm) Volume: 48174.4 (cm3) Weight: 10.20 (kg)
Low Range: High Range:
Accuracy: .50 % Refresh Rate: 1 tip/ 1 mm
Sensor type: tipping bucket
Power consumption: catalytic propane burner Moving parts: Yes

---

Equipment by Requirement Category

==========

Reference: 3.1.1.29a Precipitation, rate, liquid
Required Accuracy: 0.25 cm/hr (liquid); 1.25 cm/hr (frozen)
Required Refresh Rate: 15 (min)

==========

NovaLynx Model: 6070-A System: 00
Length: 14.2 (cm) Width: 13.7 (cm) Height: 24.1 (cm)
Diameter: 0.0 (cm) Volume: 4688.4 (cm3) Weight: 2.10 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type: photoelectric drop counter
Power consumption: 12 VDC Moving parts: No

Handar Model: 444OPT System: 00
Length: 45.7 (cm) Width: 15.2 (cm) Height: 10.0 (cm)
Diameter: 0.0 (cm) Volume: 6946.4 (cm3) Weight: 2.27 (kg)
Low Range: .5 High Range: 2000.0 mm/hr
Accuracy: .50 % Refresh Rate: 15 sec
Sensor type: optical
Power consumption: 25 mA Solar Bat Operable Moving parts: No

Surface Systems Inc Model: WIVIS SCAN RWIS System: 02
Length: 71.0 (cm) Width: 12.7 (cm) Height: 28.0 (cm)
Diameter: 0.0 (cm) Volume: 25248.0 (cm3) Weight: 15.00 (kg)
Low Range: .0 High Range: 200.0 in/hr
Accuracy: 10.00 % Refresh Rate: 1 per minute
Sensor type: WIVIS
Power consumption: 115 VAC, 48-68 Hz Moving parts: No

Reference: 3.1.1.31 Precipitation type
Required Accuracy: By type
Required Refresh Rate: 15 (min)

Surface Systems Inc Model: WIVIS SCAN RWIS System: 03
Length: 71.0 (cm) Width: 12.7 (cm) Height: 28.0 (cm)
Diameter: 0.0 (cm) Volume: 25248.0 (cm3) Weight: 15.00 (kg)
Low Range: High Range:
Accuracy: Refresh Rate: 1 per minute
Sensor type: WIVIS
Power consumption: 115 VAC, 48-68 Hz Moving parts: No

Scientific Sales Model: 301 System: 00
Length: 28.6 (cm) Width: 23.2 (cm) Height: .2 (cm)
Diameter: 0.0 (cm) Volume: 132.7 (cm3) Weight: 27.00 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type: circuit/bucket assy
Power consumption: 110 VAC or 12 VDC battery Moving parts: Yes

---

Reference: 3.1.1.32 Pressure altitude
Required Accuracy: 9 m
Required Refresh Rate: 15 (min)

Paroscientific Model: 9000 Series System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 18.9 (cm)
Diameter: 3.8 (cm) Volume: 215.5 (cm3) Weight: .40 (kg)
Low Range: 0.0 High Range: 40000.0 psia
Accuracy: .01 % Refresh Rate:
Sensor type:
Power consumption: 6-15 VDC Moving parts: No

Paroscientific Model: 6000 Series System: 00
Length: 7.3 (cm) Width: 6.7 (cm) Height: 5.7 (cm)
Diameter: 0.0 (cm) Volume: 277.0 (cm3) Weight: .43 (kg)
Low Range: 0.0 High Range: 400.0 psia
Accuracy: .01 % Refresh Rate:
Sensor type:
Power consumption: 6-15 VDC Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.32 Pressure altitude
Required Accuracy: 9 m
Required Refresh Rate: 15 (min)

Paroscientific Model: 1000 Series System: 00
Length: 12.7 (cm) Width: 7.9 (cm) Height: 7.9 (cm)
Diameter: 0.0 (cm) Volume: 796.6 (cm3) Weight: .82 (kg)
Low Range: 0.0 High Range: 10000.0 psia
Accuracy: .01 % Refresh Rate:
Sensor type:
Power consumption: 6-15 VDC Moving parts: No

Paroscientific Model: 760 SERIES System: 00
Length: 19.1 (cm) Width: 22.9 (cm) Height: 15.2 (cm)
Diameter: 0.0 (cm) Volume: 6648.3 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 40000.0 psia
Accuracy: .01 % Refresh Rate: 60 HZ
Sensor type:
Power consumption: rechargeable battery Moving parts: No

EASI Model: EZ250 PDCR 900 series System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 6.0 (cm)
Diameter: 2.5 (cm) Volume: 29.4 (cm3) Weight: .10 (kg)
Low Range: 0.0 High Range: 900.0 psia
Accuracy: .10 % Refresh Rate:
Sensor type: Hastelloy diaphragm
Power consumption: 10 Volts Moving parts: No

VIZ (ZEEMET) Model: MARK II MICROSONDE System: 02
Length: 14.4 (cm) Width: 10.2 (cm) Height: 19.3 (cm)
Diameter: 0.0 (cm) Volume: 2834.8 (cm3) Weight: .30 (kg)
Low Range: 3.0 High Range: 1080.0 mb
Accuracy: .50 mb Refresh Rate: continuous
Sensor type: continuously var capacitance aneroid
Power consumption: 12 V water activated bat Moving parts: No

AIR (Atmo Inst Rsch) Model: IS-4A series System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 0.0 (cm3) Weight: .22 (kg)
Low Range: 5.0 High Range: 1050.0 mb
Accuracy: 1.00 mb Refresh Rate:
Sensor type: Capacitance Aneroid
Power consumption: 80-200 VAC, 12V battery Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.32 Pressure altitude
Required Accuracy: 9 m
Required Refresh Rate: 15 (min)

AIR (Atmo Inst Rsch) Model: AB-2A / SB-2A System: 00
Length: 7.0 (cm) Width: 7.0 (cm) Height: 3.7 (cm)
Diameter: 0.0 (cm) Volume: 181.3 (cm3) Weight: .28 (kg)
Low Range: 800.0 High Range: 1060.0 psia
Accuracy: 5.00 % Refresh Rate: N/A
Sensor type: pressure transducer
Power consumption: 6-16 Volts Moving parts: No

AIR (Atmo Inst Rsch) Model: PT-2D /PT-2V System: 00
Length: 7.0 (cm) Width: 7.0 (cm) Height: 3.7 (cm)
Diameter: 0.0 (cm) Volume: 181.3 (cm3) Weight: .28 (kg)
Low Range: 0.0 High Range: 15.0 psia
Accuracy: 5.00 % Refresh Rate: N/A
Sensor type: pressure transducer
Power consumption: 6-16 Volts Moving parts: No

Reference: 3.1.1.33 Refractive index
Required Accuracy: N/S
Required Refresh Rate: 15 (min)

VIZ (ZEEMET) Model: W-9000 System: 00
Length: 14.6 (cm) Width: 47.0 (cm) Height: 42.1 (cm)
Diameter: 0.0 (cm) Volume: 28889.0 (cm3) Weight: 13.50 (kg)
Low Range: High Range:
Accuracy: Refresh Rate: real time
Sensor type:
Power consumption: Moving parts: No

```
==========================================================================
Reference: 3.1.1.35a   Seeability: Ultraviolet
      Required Accuracy: 10% of range
      Required Refresh Rate:   15 (min)
==========================================================================

NovaLynx                Model: 3321 UltraViolet LT Mon  System:  00
  Length:       12.1 (cm)  Width:        6.4 (cm)   Height:   4.4 (cm)
  Diameter:      0.0 (cm)  Volume:     340.7 (cm3)  Weight:    .27 (kg)
  Low Range:     0.0       High Range:   300.0 micr W/lumen
  Accuracy:                              Refresh Rate:
  Sensor type: pair of CdS photocells
  Power consumption: battery operated          Moving parts: Yes


Scientific Sales        Model: 3321 UltraViolet LT Mon  System:  00
  Length:       12.1 (cm)  Width:        6.4 (cm)   Height:   4.4 (cm)
  Diameter:      0.0 (cm)  Volume:     340.7 (cm3)  Weight:    .27 (kg)
  Low Range:     0.0       High Range:   300.0 W/lumen
  Accuracy:                              Refresh Rate:
  Sensor type: pair of CdS photocells
  Power consumption: battery operated          Moving parts: Yes

--------------------------------------------------------------------------


==========================================================================
Reference: 3.1.1.37    Solar radiation
      Required Accuracy: N/S
      Required Refresh Rate:   30 (min)
==========================================================================

Campbell Scientific     Model: Li-Cor LI-190SB Quantum  System:  00
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   2.5 (cm)
  Diameter:      2.4 (cm)  Volume:      11.5 (cm3)  Weight:    .03 (kg)
  Low Range:   400.0       High Range:   700.0 nm lt spc wb
  Accuracy:                              Refresh Rate: 10 micro sec
  Sensor type: Quantum sensor
  Power consumption: Supplied by data logger    Moving parts: No


Climatronics            Model: 100553                   System:  00
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   5.0 (cm)
  Diameter:     10.0 (cm)  Volume:     393.0 (cm3)  Weight:    .45 (kg)
  Low Range:      .3       High Range:     1.2 microns
  Accuracy:                              Refresh Rate: < 1 msec
  Sensor type: pyranometer
  Power consumption:                           Moving parts: No
```

Equipment by Requirement Category

==========

Reference: 3.1.1.37 Solar radiation
Required Accuracy: N/S
Required Refresh Rate: 30 (min)

==========

Qualimetrics Inc Model: 3020 Star Pyranometer System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 9.1 (cm)
Diameter: 15.9 (cm) Volume: 1806.9 (cm3) Weight: .86 (kg)
Low Range: .3 High Range: 3.0 microns
Accuracy: Refresh Rate: 4 sec
Sensor type: 12 wedge shaped thin copper sectors
Power consumption: Moving parts: No

Scientific Sales Model: 3020 Star Pyranometer System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 9.1 (cm)
Diameter: 15.9 (cm) Volume: 1806.9 (cm3) Weight: .86 (kg)
Low Range: .3 High Range: 3.0 microns
Accuracy: Refresh Rate: 4 sec
Sensor type: 6 black & 6 white copper segments
Power consumption: Moving parts: No

Scientific Sales Model: 3032 Net Radiometer System: 00
Length: 7.2 (cm) Width: 5.7 (cm) Height: 17.7 (cm)
Diameter: 0.0 (cm) Volume: 726.4 (cm3) Weight: .90 (kg)
Low Range: .3 High Range: 60.0 microns
Accuracy: Refresh Rate:
Sensor type: 2 black and white plates
Power consumption: Moving parts: No

Qualimetrics Inc Model: 3023 Albedometer System: 00
Length: 37.1 (cm) Width: 11.4 (cm) Height: 10.7 (cm)
Diameter: 0.0 (cm) Volume: 4525.5 (cm3) Weight: 1.59 (kg)
Low Range: .3 High Range: 3.0 microns
Accuracy: Refresh Rate: 4 sec
Sensor type: two star pyranometers
Power consumption: Moving parts: No

Qualimetrics Inc Model: 3015 Double Dome Pyrano System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 10.2 (cm)
Diameter: 19.0 (cm) Volume: 2892.0 (cm3) Weight: 2.95 (kg)
Low Range: High Range:
Accuracy: Refresh Rate: 1 sec
Sensor type: double dome
Power consumption: Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.1.1.37 Solar radiation
Required Accuracy: N/S
Required Refresh Rate: 30 (min)

==========

EASI Model: EZ510 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 9.5 (cm)
Diameter: 14.6 (cm) Volume: 1590.5 (cm3) Weight: 3.20 (kg)
Low Range: 285.0 High Range: 2800.0 millicrons
Accuracy: Refresh Rate:
Sensor type: precision spectral
Power consumption: Moving parts: No

EASI Model: EZ525 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 9.5 (cm)
Diameter: 14.6 (cm) Volume: 1590.5 (cm3) Weight: 3.20 (kg)
Low Range: 400.0 High Range: 1100.0 millicrons
Accuracy: Refresh Rate:
Sensor type: silicon photo diode sensor
Power consumption: Moving parts: No

Qualimetrics Inc Model: 3010-A Mech Pyranograph System: 00
Length: 33.0 (cm) Width: 21.0 (cm) Height: 22.2 (cm)
Diameter: 0.0 (cm) Volume: 15384.6 (cm3) Weight: 6.36 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type: black and white bimetallic strips
Power consumption: Moving parts: Yes

Li-Cor Model: LI-1800/12S System: 02
Length: 16.3 (cm) Width: 20.1 (cm) Height: 36.0 (cm)
Diameter: 0.0 (cm) Volume: 11794.7 (cm3) Weight: 6.40 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type:
Power consumption: 6V NiCad bat Moving parts: No

Climatronics Model: EWS System: 04
Length: 39.4 (cm) Width: 78.1 (cm) Height: 14.6 (cm)
Diameter: 0.0 (cm) Volume: 44926.2 (cm3) Weight: 20.00 (kg)
Low Range: High Range:
Accuracy: Refresh Rate: N/A
Sensor type:
Power consumption: Moving parts: Yes

Equipment by Requirement Category

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Reference: 3.1.1.37 Solar radiation
Required Accuracy: N/S
Required Refresh Rate: 30 (min)

==========

Weather Port Model: Weather Report WR-25/S System: 04
Length: 31.0 (cm) Width: 15.2 (cm) Height: 8.9 (cm)
Diameter: 0.0 (cm) Volume: 4193.7 (cm3) Weight: 22.50 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

Campbell Scientific Model: Li-Cor LI-200X Silicon System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 2.5 (cm)
Diameter: 2.4 (cm) Volume: 11.5 (cm3) Weight: .03 (kg)
Low Range: 400.0 High Range: 1100.0 nm lt spc wb
Accuracy: 5.00 % Refresh Rate: 10 micro sec
Sensor type: Silicon
Power consumption: Supplied by data logger Moving parts: No

Handar Model: 441A/AN System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 2.5 (cm)
Diameter: 2.4 (cm) Volume: 11.5 (cm3) Weight: .03 (kg)
Low Range: High Range:
Accuracy: 5.00 % Refresh Rate: 10 micro sec
Sensor type: Si photovoltaic detector
Power consumption: Moving parts: No

NovaLynx Model: 4015 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 2.5 (cm)
Diameter: 12.7 (cm) Volume: 321.8 (cm3) Weight: .68 (kg)
Low Range: .3 High Range: 1.2 microns
Accuracy: 5.00 % Refresh Rate: 1 ms
Sensor type: Silicon photovoltaic cell
Power consumption: Moving parts: No

Qualimetrics Inc Model: 3120 Silicon Cell Pyrano System: 00
Length: 66.0 (cm) Width: 73.7 (cm) Height: 58.4 (cm)
Diameter: 0.0 (cm) Volume: 284069.3 (cm3) Weight: 8.62 (kg)
Low Range: .3 High Range: 3.0 microns
Accuracy: 5.00 % Refresh Rate: instantaneous
Sensor type: silicon photovoltaic cell w/ shadow ring
Power consumption: Moving parts: No

Reference: 3.1.1.37 Solar radiation
Required Accuracy: N/S
Required Refresh Rate: 30 (min)

Scientific Sales Model: 3120 Silicon Cell Pyrano System: 00
Length: 66.0 (cm) Width: 73.7 (cm) Height: 58.4 (cm)
Diameter: 0.0 (cm) Volume: 284069.3 (cm3) Weight: 8.64 (kg)
Low Range: .3 High Range: 1.2 microns
Accuracy: 5.00 % Refresh Rate: instantaneous
Sensor type: silicon photovoltaic cell w/ shadow ring
Power consumption: Moving parts: No

TX Electronics Inc Model: TS-100 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 5.0 (cm)
Diameter: 10.0 (cm) Volume: 393.0 (cm3) Weight: 1.00 (kg)
Low Range: High Range:
Accuracy: 10.00 % Refresh Rate:
Sensor type: 48 junction thermopile blk & white pyran
Power consumption: Moving parts: No

Reference: 3.1.1.40 Temperature, air, surface
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

Vaisala Model: HMP 35D System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.0 (cm)
Diameter: 2.5 (cm) Volume: 147.0 (cm3) Weight: .17 (kg)
Low Range: -40.0 High Range: 80.0 deg C
Accuracy: Refresh Rate:
Sensor type: Pt100 1/3 DIN 43760B
Power consumption: 7-35 VDC Moving parts: No

TX Electronics Inc Model: TT-101 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 19.7 (cm)
Diameter: 18.4 (cm) Volume: 5238.3 (cm3) Weight: .45 (kg)
Low Range: -40.0 High Range: 50.0 deg C
Accuracy: Refresh Rate:
Sensor type: linear thermistor-resistor network
Power consumption: Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.40 Temperature, air, surface
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

Scientific Sales Model: WeatherMax System: 03
Length: 25.0 (cm) Width: 23.0 (cm) Height: 9.0 (cm)
Diameter: 0.0 (cm) Volume: 5175.0 (cm3) Weight: 2.00 (kg)
Low Range: -40.0 High Range: 50.0 deg C
Accuracy: Refresh Rate:
Sensor type:
Power consumption: 12 VDC Moving parts: No

METOCEAN Model: Ice Platform System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 350.0 (cm)
Diameter: 69.0 (cm) Volume: 1308751.3 (cm3) Weight: 250.00 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type: TOGA style drifter (ARGOS)
Power consumption: Battery Moving parts: Yes

MET ONE Model: AutoMet System: 02
Length: 61.0 (cm) Width: 30.0 (cm) Height: 183.0 (cm)
Diameter: 0.0 (cm) Volume: 334890.0 (cm3) Weight: 0.00 (kg)
Low Range: -30.0 High Range: 50.0 deg C
Accuracy: .05 deg C Refresh Rate: instantenous
Sensor type:
Power consumption: 12 VDC Int Bat Pk Moving parts: Yes

AIR (Atmo Inst Rsch) Model: CT-1A-T / FT-1A-T System: 00
Length: 7.0 (cm) Width: 12.0 (cm) Height: 5.0 (cm)
Diameter: 0.0 (cm) Volume: 420.0 (cm3) Weight: .45 (kg)
Low Range: High Range:
Accuracy: .05 deg C Refresh Rate: .1 to 25 Hz
Sensor type: 2 platinum wire probes
Power consumption: 15 VDC Moving parts: No

MET ONE Model: 060 SERIES System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 0.0 (cm3) Weight: 0.00 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .10 deg C Refresh Rate: N/A
Sensor type:
Power consumption: Moving parts:

Equipment by Requirement Category

Reference: 3.1.1.40 Temperature, air, surface
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

Climatronics Model: 100093-2 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 11.4 (cm)
Diameter: .6 (cm) Volume: 3.7 (cm3) Weight: 0.00 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .10 deg C Refresh Rate: 3.6 SEC
Sensor type: thermistor bead expanded range
Power consumption: Moving parts: No

Climatronics Model: 100826 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 15.2 (cm)
Diameter: .6 (cm) Volume: 4.9 (cm3) Weight: 0.00 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .10 deg C Refresh Rate: 5.5 SEC
Sensor type: Platinum 4-Wire
Power consumption: Moving parts: No

Scientific Sales Model: 4470-A Qualimetrics System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 15.2 (cm)
Diameter: 1.0 (cm) Volume: 11.9 (cm3) Weight: .10 (kg)
Low Range: -50.0 High Range: 100.0 deg C
Accuracy: .10 deg C Refresh Rate: 15 sec
Sensor type: 1000 ohm Platinum RTD
Power consumption: Moving parts: No

Scientific Sales Model: Qualimetrics 5129 D/E System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 21.6 (cm)
Diameter: 1.9 (cm) Volume: 61.2 (cm3) Weight: .23 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .10 deg C Refresh Rate:
Sensor type: 3 element composite linear thermistor
Power consumption: 5-20 VDC Moving parts: No

MET ONE Model: AutoMet 25 System: 02
Length: 20.0 (cm) Width: 20.0 (cm) Height: 20.0 (cm)
Diameter: 0.0 (cm) Volume: 8000.0 (cm3) Weight: 2.00 (kg)
Low Range: -30.0 High Range: 50.0 deg C
Accuracy: .10 deg C Refresh Rate:
Sensor type:
Power consumption: 12 VDC, battery, solar Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.40 Temperature, air, surface
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

==========

Climatronics Model: 100093 / 100093-1 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 11.4 (cm)
Diameter: .6 (cm) Volume: 3.7 (cm3) Weight: 0.00 (kg)
Low Range: -33.0 High Range: 50.0 deg C
Accuracy: .15 deg C Refresh Rate: 3.6 SEC
Sensor type: thermistor bead
Power consumption: Moving parts: No

Climatronics Model: 100093-3 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 11.4 (cm)
Diameter: .6 (cm) Volume: 3.7 (cm3) Weight: 0.00 (kg)
Low Range: -30.0 High Range: 50.0 deg C
Accuracy: .15 deg C Refresh Rate: .6 SEC
Sensor type: Fast Response
Power consumption: Moving parts: No

Scientific Sales Model: 4480 Qualimeteric System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 13.3 (cm)
Diameter: 1.1 (cm) Volume: 12.6 (cm3) Weight: .10 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .20 deg C Refresh Rate: 1.4 minutes
Sensor type: 3 element composite thermistor
Power consumption: Moving parts: No

Handar Model: 432/A System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 24.6 (cm)
Diameter: 1.9 (cm) Volume: 69.7 (cm3) Weight: .13 (kg)
Low Range: -50.0 High Range: 60.0 deg C
Accuracy: .20 deg C Refresh Rate: N/A
Sensor type: thermistor
Power consumption: 10-15 VDC Moving parts: No

Handar Model: 435A System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 24.6 (cm)
Diameter: 1.9 (cm) Volume: 69.7 (cm3) Weight: .13 (kg)
Low Range: -50.0 High Range: 60.0 deg C
Accuracy: .20 deg C Refresh Rate:
Sensor type: thermistor
Power consumption: 10 - 15 VDC Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.40 Temperature, air, surface
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

VIZ (ZEEMET) Model: MARK II MICROSONDE System: 03
Length: 14.4 (cm) Width: 10.2 (cm) Height: 19.3 (cm)
Diameter: 0.0 (cm) Volume: 2834.8 (cm3) Weight: .30 (kg)
Low Range: -90.0 High Range: 60.0 deg C
Accuracy: .20 deg C Refresh Rate: 1 SEC
Sensor type: thin rod thermistor
Power consumption: 12 V water activated bat Moving parts: No

Campbell Scientific Model: Vaisala HMP35C System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 25.4 (cm)
Diameter: 2.5 (cm) Volume: 129.0 (cm3) Weight: 1.00 (kg)
Low Range: -35.0 High Range: 50.0 deg C
Accuracy: .20 deg C Refresh Rate: N/A
Sensor type: Cap Polymer H Chip
Power consumption: 12VDC Moving parts: No

EASI Model: EZ310 System: 00
Length: 5.0 (cm) Width: 7.6 (cm) Height: 12.7 (cm)
Diameter: 0.0 (cm) Volume: 483.0 (cm3) Weight: 1.00 (kg)
Low Range: -50.0 High Range: 75.0 deg C
Accuracy: .20 deg C Refresh Rate:
Sensor type: YSI precision thermistor
Power consumption: 12 - 36 VDC Moving parts: No

Handar Model: 447B System: 01
Length: 7.6 (cm) Width: 7.6 (cm) Height: 15.0 (cm)
Diameter: 0.0 (cm) Volume: 866.0 (cm3) Weight: 1.00 (kg)
Low Range: -55.0 High Range: 55.0 deg C
Accuracy: .25 deg C Refresh Rate: 10 sec
Sensor type: Precision Thermistor
Power consumption: Moving parts: No

METOCEAN Model: CMOD System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 91.4 (cm)
Diameter: 12.2 (cm) Volume: 10684.6 (cm3) Weight: 12.73 (kg)
Low Range: -20.0 High Range: 44.0 deg C
Accuracy: .25 deg C Refresh Rate:
Sensor type: ARGOS Drifting buoy (ARGOS)
Power consumption: 5 - 17.6 V battery Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.40 Temperature, air, surface
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

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Scientific Sales Model: 4481 Qualimetrics System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 13.3 (cm)
Diameter: 1.1 (cm) Volume: 12.6 (cm3) Weight: .10 (kg)
Low Range: -30.0 High Range: 50.0 deg C
Accuracy: .30 deg C Refresh Rate: 1.4 minutes
Sensor type: 2 element composite thermistor
Power consumption: Moving parts: No

Scientific Sales Model: 41372/43372 System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 7.6 (cm)
Diameter: 2.5 (cm) Volume: 38.5 (cm3) Weight: .10 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .30 deg C Refresh Rate:
Sensor type: 1000 ohm Platinum RTD
Power consumption: 8-24 VDC / 9mA Moving parts: No

AIR (Atmo Inst Rsch) Model: HA-1P System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.0 (cm)
Diameter: 1.9 (cm) Volume: 85.1 (cm3) Weight: .14 (kg)
Low Range: -40.0 High Range: 60.0 deg C
Accuracy: .30 deg C Refresh Rate: 10 SEC
Sensor type: 500 ohm RTD, thin film platinum
Power consumption: 5mA @ 7 Volts Moving parts: No

Young Meteor. Inst Model: 41372/43372 System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 16.5 (cm)
Diameter: 2.5 (cm) Volume: 81.0 (cm3) Weight: .20 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .30 deg C Refresh Rate:
Sensor type: 1000 ohm Platinum RTD
Power consumption: 8-24 VDC / 9mA Moving parts: No

NovaLynx Model: HM34 System: 02
Length: 16.0 (cm) Width: 5.7 (cm) Height: 2.7 (cm)
Diameter: 0.0 (cm) Volume: 246.2 (cm3) Weight: .23 (kg)
Low Range: -20.0 High Range: 60.0 deg C
Accuracy: .30 deg C Refresh Rate:
Sensor type: Pt 100 1/3 DIN 43760B
Power consumption: 9 Volt battery Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.1.1.40 Temperature, air, surface
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

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Climatronics Model: TACMET System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 32.4 (cm)
Diameter: 10.2 (cm) Volume: 2647.5 (cm3) Weight: .77 (kg)
Low Range: -50.0 High Range: 55.0 deg C
Accuracy: .30 deg C Refresh Rate: N/A
Sensor type: IREMBAS COTS Wx Module
Power consumption: 12 VDC @ 10mA Moving parts: Yes

Young Meteor. Inst Model: 41402 / 41406 System: 00
Length: 20.0 (cm) Width: 16.0 (cm) Height: 16.5 (cm)
Diameter: 0.0 (cm) Volume: 5280.0 (cm3) Weight: 2.30 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .30 deg C Refresh Rate:
Sensor type: 1000 ohm Platinum RTD
Power consumption: 115 VAC 11W Moving parts: No

Young Meteor. Inst Model: 41404 / 41408 System: 00
Length: 20.0 (cm) Width: 16.0 (cm) Height: 16.5 (cm)
Diameter: 0.0 (cm) Volume: 5280.0 (cm3) Weight: 2.30 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .30 deg C Refresh Rate:
Sensor type: 1000 ohm Platinum RTD
Power consumption: 115 VAC 11W Moving parts: No

NovaLynx Model: 2046T System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 6.3 (cm)
Diameter: 1.0 (cm) Volume: 4.6 (cm3) Weight: .18 (kg)
Low Range: -40.0 High Range: 60.0 deg C
Accuracy: .50 deg C Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

Davis Instruments Model: Perception II System: 02
Length: 13.3 (cm) Width: 14.9 (cm) Height: 7.7 (cm)
Diameter: 0.0 (cm) Volume: 1525.9 (cm3) Weight: .50 (kg)
Low Range: 0.0 High Range: 60.0 deg C
Accuracy: .50 deg C Refresh Rate: N/A
Sensor type:
Power consumption: AC with battery backup Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.40 Temperature, air, surface
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

Davis Instruments Model: Weather Monitor II System: 03
Length: 13.3 (cm) Width: 14.9 (cm) Height: 7.7 (cm)
Diameter: 0.0 (cm) Volume: 1525.9 (cm3) Weight: .50 (kg)
Low Range: -46.0 High Range: 60.0 deg C
Accuracy: .50 deg C Refresh Rate: N/A
Sensor type:
Power consumption: AC with battery backup Moving parts: Yes

Davis Instruments Model: Weather Wizard III System: 02
Length: 13.3 (cm) Width: 14.9 (cm) Height: 7.7 (cm)
Diameter: 0.0 (cm) Volume: 1525.9 (cm3) Weight: .50 (kg)
Low Range: -46.0 High Range: 60.0 deg C
Accuracy: .50 deg C Refresh Rate: N/A
Sensor type:
Power consumption: AC with battery backup Moving parts: Yes

Handar Model: 435C System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 19.6 (cm)
Diameter: 2.5 (cm) Volume: 99.3 (cm3) Weight: .68 (kg)
Low Range: -30.0 High Range: 70.0 deg C
Accuracy: .50 deg C Refresh Rate: N/A
Sensor type: Platinum RT
Power consumption: 8 to 35 VDC,10mA Moving parts: No

Climatronics Model: METRAC System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 83.3 (cm)
Diameter: 10.0 (cm) Volume: 6542.4 (cm3) Weight: 5.00 (kg)
Low Range: -50.0 High Range: 55.0 deg C
Accuracy: .50 deg C Refresh Rate: N/A
Sensor type: IREMBAS COTS Wx Module
Power consumption: 12 V or rechargeable bat. Moving parts: Yes

Climatronics Model: EWS System: 05
Length: 39.4 (cm) Width: 78.1 (cm) Height: 14.6 (cm)
Diameter: 0.0 (cm) Volume: 44926.2 (cm3) Weight: 20.00 (kg)
Low Range: -30.0 High Range: 20.0 deg C
Accuracy: .50 deg C Refresh Rate: N/A
Sensor type: thermistor
Power consumption: AC/DC Moving parts: Yes

Equipment by Requirement Category

Reference: 3.1.1.40 Temperature, air, surface
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

EASI Model: EZ325 System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 0.0 (cm3) Weight: 0.00 (kg)
Low Range: 4.0 High Range: 49.0 deg C
Accuracy: 1.00 % Refresh Rate:
Sensor type: Dewpoint transducer
Power consumption: 24 - 36 VDC Moving parts: No

Scientific Sales Model: 5191 System: 02
Length: 2.5 (cm) Width: 5.0 (cm) Height: 7.6 (cm)
Diameter: 0.0 (cm) Volume: 950.0 (cm3) Weight: .20 (kg)
Low Range: 0.0 High Range: 60.0 deg C
Accuracy: 1.00 deg C Refresh Rate:
Sensor type:
Power consumption: 9 V battery Moving parts: No

NovaLynx Model: 110-WS-10T Wind Station System: 01
Length: 46.0 (cm) Width: 61.0 (cm) Height: 46.0 (cm)
Diameter: 0.0 (cm) Volume: 5612.0 (cm3) Weight: 1.10 (kg)
Low Range: -40.0 High Range: 60.0 deg C
Accuracy: 1.00 deg C Refresh Rate: 1.5 sec
Sensor type:
Power consumption: Gameport Interface Moving parts: Yes

NovaLynx Model: 110-WS-12 Wind Station System: 01
Length: 9.7 (cm) Width: 16.0 (cm) Height: 3.6 (cm)
Diameter: 0.0 (cm) Volume: 558.7 (cm3) Weight: 1.36 (kg)
Low Range: -40.0 High Range: 60.0 deg C
Accuracy: 1.00 deg C Refresh Rate: real time
Sensor type:
Power consumption: Parallel Port Interface Moving parts: Yes

WeatherPort NovaLynx Model: WS-10T Wind Station System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 19.0 (cm)
Diameter: 2.5 (cm) Volume: 96.3 (cm3) Weight: 1.36 (kg)
Low Range: -40.0 High Range: 60.0 deg C
Accuracy: 1.00 deg C Refresh Rate:
Sensor type:
Power consumption: Gameport interface Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.40 Temperature, air, surface
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

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NovaLynx Model: TFV4056 System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 32.0 (cm)
Diameter: 10.5 (cm) Volume: 2770.9 (cm3) Weight: 2.20 (kg)
Low Range: -40.0 High Range: 70.0 deg C
Accuracy: 1.00 % Refresh Rate: 10 msec
Sensor type:
Power consumption: 24 VDC Moving parts: No

Scientific Sales Model: WST7000 Weather Station System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 40.0 (cm)
Diameter: 10.5 (cm) Volume: 3463.6 (cm3) Weight: 2.20 (kg)
Low Range: -40.0 High Range: 70.0 deg C
Accuracy: 1.00 deg C Refresh Rate: 10 msec
Sensor type:
Power consumption: 24 VDC Moving parts: No

MesoTech Internation Model: NBC 5056 Auto WX Station System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 55.0 (cm)
Diameter: 8.0 (cm) Volume: 2764.6 (cm3) Weight: 3.20 (kg)
Low Range: -50.0 High Range: 70.0 deg C
Accuracy: 1.00 deg C Refresh Rate: 10 msec
Sensor type:
Power consumption: 24 VDC opt power supply Moving parts: No

METOCEAN Model: Ice Beacon System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 31.0 (cm)
Diameter: 54.0 (cm) Volume: 70997.0 (cm3) Weight: 20.00 (kg)
Low Range: -40.0 High Range: 11.0 deg C
Accuracy: 1.00 deg C Refresh Rate:
Sensor type: Data sent to ARGOS
Power consumption: 5 - 17.6 V battery Moving parts: Yes

Weather Port Model: Weather Report WR-25/C System: 02
Length: 31.0 (cm) Width: 15.2 (cm) Height: 8.9 (cm)
Diameter: 0.0 (cm) Volume: 4193.7 (cm3) Weight: 22.50 (kg)
Low Range: -57.0 High Range: 60.0 deg C
Accuracy: 1.00 deg C Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.1.1.40 Temperature, air, surface
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

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Weather Port Model: Weather Report WR-25/S System: 05
Length: 31.0 (cm) Width: 15.2 (cm) Height: 8.9 (cm)
Diameter: 0.0 (cm) Volume: 4193.7 (cm3) Weight: 22.50 (kg)
Low Range: -57.0 High Range: 60.0 deg C
Accuracy: 1.00 deg C Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

METOCEAN Model: Standard Drifter System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 350.0 (cm)
Diameter: 69.0 (cm) Volume: 1308751.3 (cm3) Weight: 95.00 (kg)
Low Range: -20.0 High Range: 44.0 deg C
Accuracy: 1.00 deg C Refresh Rate:
Sensor type: (TIROS/ARGOS)
Power consumption: Alkaline Bat (5-17.6V) Moving parts: No

Scientific Sales Model: 9000 Mobile-Met System: 03
Length: 33.0 (cm) Width: 25.4 (cm) Height: 15.2 (cm)
Diameter: 0.0 (cm) Volume: 12740.6 (cm3) Weight: 3.60 (kg)
Low Range: High Range:
Accuracy: 1.50 deg C Refresh Rate:
Sensor type:
Power consumption: 6-12 AA, 12-18 VDC Moving parts: Yes

Applied Tech. Inc Model: V style System: 01
Length: 17.8 (cm) Width: 17.8 (cm) Height: 17.8 (cm)
Diameter: 7.6 (cm) Volume: 5637.8 (cm3) Weight: .45 (kg)
Low Range: -20.0 High Range: 50.0 deg C
Accuracy: 2.00 deg C Refresh Rate: 10 samples/sec
Sensor type: V style sonic Array
Power consumption: 110-120V (DC opt) Moving parts: No

Qualimetrics Inc Model: 9000 TAMS System: 03
Length: 22.9 (cm) Width: 9.5 (cm) Height: 4.3 (cm)
Diameter: 0.0 (cm) Volume: 935.5 (cm3) Weight: .90 (kg)
Low Range: -45.0 High Range: 55.0 deg C
Accuracy: 2.00 deg C Refresh Rate:
Sensor type:
Power consumption: 6-12 AA, DC, Lith bat Moving parts: Yes

Equipment by Requirement Category

Reference: 3.1.1.40 Temperature, air, surface
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

Applied Tech. Inc Model: K and Sx style System: 01
Length: 25.4 (cm) Width: 35.6 (cm) Height: 40.6 (cm)
Diameter: 0.0 (cm) Volume: 36712.1 (cm3) Weight: 1.00 (kg)
Low Range: -20.0 High Range: 50.0 deg C
Accuracy: 2.00 deg C Refresh Rate: 10 samples/sec
Sensor type: K and Sx style sonic Array
Power consumption: 110-120V (DC opt) Moving parts: No

TX Wx Inst Inc Model: Weather Report System System: 02
Length: 31.0 (cm) Width: 15.2 (cm) Height: 8.9 (cm)
Diameter: 0.0 (cm) Volume: 4193.7 (cm3) Weight: 22.50 (kg)
Low Range: -57.0 High Range: 60.0 deg C
Accuracy: 2.00 % Refresh Rate: instantaneous
Sensor type:
Power consumption: RS 232 adapter Moving parts: Yes

EASI Model: EZ305 / EZ315 System: 00
Length: 5.0 (cm) Width: 7.6 (cm) Height: 12.7 (cm)
Diameter: 0.0 (cm) Volume: 483.0 (cm3) Weight: 1.00 (kg)
Low Range: -40.0 High Range: 71.0 deg C
Accuracy: 10.00 % Refresh Rate: N/A
Sensor type: PT100 platinum RTD
Power consumption: 12 VDC Moving parts: No

```
==========================================================================
Reference: 3.1.1.41    Temperature, air, profile
      Required Accuracy: 1 deg C
      Required Refresh Rate:   15 (min)
==========================================================================

REMTECH                    Model: R.A.S.S.                    System:  00
  Length:     1300.0 (cm)  Width:     1300.0 (cm)   Height:1300.0 (cm)
  Diameter:      0.0 (cm)  Volume: ********* (cm3)  Weight:   0.00 (kg)
  Low Range:     0.0       High Range:  3000.0 m
  Accuracy:       .20 deg C                 Refresh Rate:
  Sensor type:
  Power consumption:                            Moving parts: No


Radian                     Model: LAP-3000a                   System:  01
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   1.0 (cm)
  Diameter:      0.0 (cm)  Volume:       0.0 (cm3)  Weight:   0.00 (kg)
  Low Range:   100.0       High Range:  2000.0 m
  Accuracy:      1.00 deg C                 Refresh Rate: real time
  Sensor type:
  Power consumption:                            Moving parts: No

--------------------------------------------------------------------------


==========================================================================
Reference: 3.1.1.42    Temperature, air, upper
      Required Accuracy: 1 deg C
      Required Refresh Rate:   15 (min)
==========================================================================

AIR (Atmo Inst Rsch)   Model: IS-4A series                System:  03
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   1.0 (cm)
  Diameter:      0.0 (cm)  Volume:       0.0 (cm3)  Weight:    .22 (kg)
  Low Range:   -90.0       High Range:    50.0 deg C
  Accuracy:       .50 deg C                 Refresh Rate:
  Sensor type: Thermistor
  Power consumption: 80-200 VAC, 12V battery    Moving parts: No

--------------------------------------------------------------------------
```

Equipment by Requirement Category

==========

Reference: 3.1.1.43 Temperature, dewpoint
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

==========

Scientific Sales Model: WeatherMax System: 04
Length: 25.0 (cm) Width: 23.0 (cm) Height: 9.0 (cm)
Diameter: 0.0 (cm) Volume: 5175.0 (cm3) Weight: 2.00 (kg)
Low Range: -18.0 High Range: 50.0 deg C
Accuracy: Refresh Rate:
Sensor type:
Power consumption: 12 VDC Moving parts: No

Scientific Sales Model: 9000 Mobile-Met System: 04
Length: 33.0 (cm) Width: 25.4 (cm) Height: 15.2 (cm)
Diameter: 0.0 (cm) Volume: 12740.6 (cm3) Weight: 3.60 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type:
Power consumption: 6-12 AA, 12-18 VDC Moving parts: Yes

EASI Model: EZ325 System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 0.0 (cm3) Weight: 0.00 (kg)
Low Range: -18.0 High Range: 38.0 deg C
Accuracy: 1.00 % Refresh Rate:
Sensor type: Dewpoint transducer
Power consumption: 24 - 36 VDC Moving parts: No

Climatronics Model: 101197 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 1.6 (cm)
Diameter: 2.2 (cm) Volume: 6.2 (cm3) Weight: 0.00 (kg)
Low Range: -40.0 High Range: 42.0 deg C
Accuracy: 1.00 deg C Refresh Rate: airflow depend
Sensor type: thermistor temp sensor
Power consumption: 24 V Moving parts: No

Climatronics Model: EWS System: 06
Length: 39.4 (cm) Width: 78.1 (cm) Height: 14.6 (cm)
Diameter: 0.0 (cm) Volume: 44926.2 (cm3) Weight: 20.00 (kg)
Low Range: -40.0 High Range: 25.0 deg C
Accuracy: 1.00 deg C Refresh Rate: N/A
Sensor type:
Power consumption: Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.43 Temperature, dewpoint
Required Accuracy: 1 deg C
Required Refresh Rate: 15 (min)

==========

Scientific Sales Model: Qual. Dew Cells 5320 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 9.5 (cm)
Diameter: 1.0 (cm) Volume: 7.5 (cm3) Weight: .23 (kg)
Low Range: -40.0 High Range: 40.0 deg C
Accuracy: 1.30 deg C Refresh Rate: 2 min
Sensor type: thermistor composite
Power consumption: 2.4 VA Moving parts: No

Handar Model: 447B System: 02
Length: 7.6 (cm) Width: 7.6 (cm) Height: 15.0 (cm)
Diameter: 0.0 (cm) Volume: 866.0 (cm3) Weight: 1.00 (kg)
Low Range: -34.0 High Range: 32.0 deg C
Accuracy: 1.70 deg C Refresh Rate: N/A
Sensor type: Capacitance RH
Power consumption: Moving parts: No

Scientific Sales Model: Qual. Dew Cells 5321 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 9.5 (cm)
Diameter: 1.0 (cm) Volume: 7.5 (cm3) Weight: .23 (kg)
Low Range: -40.0 High Range: 40.0 deg C
Accuracy: 1.80 deg C Refresh Rate: 2 min
Sensor type: platinum wire, 100 ohms at 0 DEG C
Power consumption: 2.4 VA Moving parts: No

MET ONE Model: 078B System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 0.0 (cm3) Weight: 0.00 (kg)
Low Range: -40.0 High Range: 50.0 deg C
Accuracy: 3.50 deg C Refresh Rate: N/A
Sensor type:
Power consumption: Moving parts:

```
======================================================================
Reference: 3.1.1.45    Temperature, EQ wind chill index
      Required Accuracy: 3 deg C
      Required Refresh Rate:   15 (min)
======================================================================

Davis Instruments      Model: Weather Monitor II       System:  04
  Length:       13.3 (cm)  Width:       14.9 (cm)   Height:   7.7 (cm)
  Diameter:      0.0 (cm)  Volume:    1525.9 (cm3)  Weight:    .50 (kg)
  Low Range:   -92.0       High Range:    60.0 deg C
  Accuracy:      2.00 deg C                 Refresh Rate: N/A
  Sensor type:
  Power consumption: AC with battery backup     Moving parts: Yes


Davis Instruments      Model: Weather Wizard III       System:  03
  Length:       13.3 (cm)  Width:       14.9 (cm)   Height:   7.7 (cm)
  Diameter:      0.0 (cm)  Volume:    1525.9 (cm3)  Weight:    .50 (kg)
  Low Range:   -92.0       High Range:    60.0 deg C
  Accuracy:      2.00 deg C                 Refresh Rate: N/A
  Sensor type:
  Power consumption: AC with battery backup     Moving parts: Yes

----------------------------------------------------------------------


======================================================================
Reference: 3.1.1.50    Turbulence, optical
      Required Accuracy: N/S
      Required Refresh Rate:   30 (min)
======================================================================

Scintec                Model: SLS 20                   System:  00
  Length:       63.0 (cm)  Width:       11.0 (cm)   Height:  11.0 (cm)
  Diameter:      0.0 (cm)  Volume:    7623.0 (cm3)  Weight:   2.90 (kg)
  Low Range:               High Range:
  Accuracy:                                  Refresh Rate:
  Sensor type:
  Power consumption:                             Moving parts: No

----------------------------------------------------------------------
```

==========

Reference: 3.1.1.51 Visibility, visible spectrum
Required Accuracy: 10% of range
Required Refresh Rate: 15 (min)

==========

Li-Cor Model: LI-210SA Photometric Sen System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 2.5 (cm)
Diameter: 2.4 (cm) Volume: 11.3 (cm3) Weight: .03 (kg)
Low Range: High Range:
Accuracy: Refresh Rate: 10 micro sec
Sensor type: Photometric sensor
Power consumption: Moving parts: No

Air Resource Spec In Model: Optec LPV-2 System: 00
Length: 46.0 (cm) Width: 13.0 (cm) Height: 13.0 (cm)
Diameter: 0.0 (cm) Volume: 7774.0 (cm3) Weight: 7.00 (kg)
Low Range: High Range:
Accuracy: Refresh Rate: 1 minute
Sensor type: Transmissometer system
Power consumption: 12VDC, or solar power Moving parts: Yes

Vaisala Model: FD 12 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 210.0 (cm)
Diameter: 160.0 (cm) Volume: 4222310.4 (cm3) Weight: 20.00 (kg)
Low Range: 32.0 High Range: 65500.0 ft
Accuracy: Refresh Rate:
Sensor type: measure scatter of infrared light in air
Power consumption: 30 VA Moving parts: No

Qualimetrics Inc Model: 8364 Frwd sctr vis sen System: 00
Length: 155.0 (cm) Width: 48.0 (cm) Height: 53.0 (cm)
Diameter: 0.0 (cm) Volume: 394320.0 (cm3) Weight: 33.50 (kg)
Low Range: 0.0 High Range: 20.0 miles
Accuracy: Refresh Rate: 3,5,10 min int
Sensor type: Silicon photodiode
Power consumption: 200 VA Moving parts: No

Air Resource Spec In Model: Automatic Camera System: 00
Length: 46.0 (cm) Width: 31.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 0.0 (cm3) Weight: 37.00 (kg)
Low Range: 1.0 High Range: 16.0 pics/day
Accuracy: Refresh Rate: N/A
Sensor type: Automatic Camera
Power consumption: Battery powered Moving parts: Yes

Equipment by Requirement Category

Reference: 3.1.1.51 Visibility, visible spectrum
Required Accuracy: 10% of range
Required Refresh Rate: 15 (min)

Air Resource Spec In Model: Optec NGN-2 System: 00
Length: 30.0 (cm) Width: 30.0 (cm) Height: 213.0 (cm)
Diameter: 0.0 (cm) Volume: 191700.0 (cm3) Weight: 68.00 (kg)
Low Range: .0 High Range: 20.0 Rayleigh
Accuracy: 10.00 % Refresh Rate: continuous
Sensor type: Nephelometer system
Power consumption: 13.8 VDC Moving parts: Yes

Handar Model: 470A/B System: 00
Length: 22.9 (cm) Width: 76.2 (cm) Height: 121.9 (cm)
Diameter: 0.0 (cm) Volume: 212713.1 (cm3) Weight: 8.18 (kg)
Low Range: .2 High Range: 18.0 mi
Accuracy: 15.00 % Refresh Rate: .1 sec
Sensor type: Forward scatter
Power consumption: 120 VAC, 12VDC Moving parts: No

Surface Systems Inc Model: WIVIS SCAN RWIS System: 04
Length: 71.0 (cm) Width: 12.7 (cm) Height: 28.0 (cm)
Diameter: 0.0 (cm) Volume: 25248.0 (cm3) Weight: 15.00 (kg)
Low Range: .0 High Range: 7.0 mi
Accuracy: 20.00 % Refresh Rate: 1 per minute
Sensor type: WIVIS
Power consumption: 115 VAC, 48-68 Hz Moving parts: No

Equipment by Requirement Category

```
==================================================================
Reference: 3.1.1.52a   Wind, profile, speed
      Required Accuracy: 1 Kt (.515 m/sec)
      Required Refresh Rate:   15 (min)
==================================================================

Applied Tech. Inc      Model: Mini Radar Wind Profiler System:  01
  Length:       91.0 (cm)  Width:       61.0 (cm)   Height: 122.0 (cm)
  Diameter:      0.0 (cm)  Volume:  677222.0 (cm3)  Weight:  23.00 (kg)
  Low Range:   100.0       High Range:  3000.0 m
  Accuracy:       .25 m/sec                 Refresh Rate: 1 minute
  Sensor type: wind profiling radar
  Power consumption: 110-120V                    Moving parts: No


REMTECH                Model: HPPA1                      System:  01
  Length:     2560.0 (cm)  Width:     2560.0 (cm)   Height:2560.0 (cm)
  Diameter:      0.0 (cm)  Volume: ********* (cm3)  Weight:  45.00 (kg)
  Low Range:    50.0       High Range:  5000.0 m
  Accuracy:       .30 m/sec                 Refresh Rate: real time
  Sensor type: phased array sodar
  Power consumption:                             Moving parts: No


REMTECH                Model: PA1 (x52)                  System:  01
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  90.0 (cm)
  Diameter:     30.0 (cm)  Volume:   63600.0 (cm3)  Weight: 700.00 (kg)
  Low Range:    50.0       High Range:  1000.0 m
  Accuracy:       .30 m/sec                 Refresh Rate: real time
  Sensor type: phased array sodar
  Power consumption:                             Moving parts: No


REMTECH                Model: PA2 (x196)                 System:  01
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  90.0 (cm)
  Diameter:     30.0 (cm)  Volume:   63600.0 (cm3)  Weight:2673.00 (kg)
  Low Range:    50.0       High Range:  1500.0 m
  Accuracy:       .30 m/sec                 Refresh Rate: real time
  Sensor type: phased array sodar
  Power consumption:                             Moving parts: No


REMTECH                Model: PA3 (x432)                 System:  01
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  90.0 (cm)
  Diameter:     30.0 (cm)  Volume:   63600.0 (cm3)  Weight:5890.00 (kg)
  Low Range:    50.0       High Range:  2000.0 m
  Accuracy:       .30 m/sec                 Refresh Rate: real time
  Sensor type: phased array sodar
  Power consumption:                             Moving parts: No
```

Equipment by Requirement Category

```
================================================================
Reference: 3.1.1.52a   Wind, profile, speed
      Required Accuracy: 10 deg, 1 Kt (.515 m/sec)
      Required Refresh Rate:   15 (min)
================================================================

Radian                    Model: LAP-3000a                System:  02
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:   1.0 (cm)
  Diameter:     0.0 (cm)  Volume:       0.0 (cm3)  Weight:   0.00 (kg)
  Low Range:  100.0       High Range:  5000.0 m
  Accuracy:     1.00 m/sec                Refresh Rate: real time
  Sensor type:
  Power consumption:                        Moving parts: No

----------------------------------------------------------------


================================================================
Reference: 3.1.1.52b   Wind, profile, direction
      Required Accuracy: 10 deg, 1 Kt
      Required Refresh Rate:   15 (min)
================================================================

Radian                    Model: LAP-3000a                System:  03
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:   1.0 (cm)
  Diameter:     0.0 (cm)  Volume:       0.0 (cm3)  Weight:   0.00 (kg)
  Low Range:  100.0       High Range:  5000.0 m
  Accuracy:                             Refresh Rate:
  Sensor type:
  Power consumption:                        Moving parts:


Applied Tech. Inc         Model: Mini Radar Wind Profiler System:  02
  Length:      91.0 (cm)  Width:       61.0 (cm)   Height: 122.0 (cm)
  Diameter:     0.0 (cm)  Volume:  677222.0 (cm3)  Weight:  23.00 (kg)
  Low Range:  100.0       High Range:   360.0 deg
  Accuracy:          deg                Refresh Rate: 1 minute
  Sensor type: wind profiling radar
  Power consumption: 110-120V               Moving parts: No


REMTECH                   Model: HPPA1                    System:  02
  Length:    2560.0 (cm)  Width:    2560.0 (cm)   Height:2560.0 (cm)
  Diameter:     0.0 (cm)  Volume: ********* (cm3)  Weight:  45.00 (kg)
  Low Range:   50.0       High Range:  5000.0 m
  Accuracy:                             Refresh Rate:
  Sensor type: phased array sodar
  Power consumption:                        Moving parts: No
```

Equipment by Requirement Category

```
==================================================================
Reference: 3.1.1.52b   Wind, profile, direction
      Required Accuracy: 10 deg, 1 Kt
      Required Refresh Rate:   15 (min)
==================================================================

REMTECH                  Model: PA1 (x52)                 System:  02
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  90.0 (cm)
  Diameter:    30.0 (cm)  Volume:   63600.0 (cm3)  Weight: 700.00 (kg)
  Low Range:   50.0       High Range:  1000.0 m
  Accuracy:                                  Refresh Rate:
  Sensor type: phased array sodar
  Power consumption:                             Moving parts: No


REMTECH                  Model: PA2 (x196)                System:  02
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  90.0 (cm)
  Diameter:    30.0 (cm)  Volume:   63600.0 (cm3)  Weight:2673.00 (kg)
  Low Range:   50.0       High Range:  1500.0 m
  Accuracy:                                  Refresh Rate:
  Sensor type: phased array sodar
  Power consumption:                             Moving parts: No


REMTECH                  Model: PA3 (x432)                System:  02
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  90.0 (cm)
  Diameter:    30.0 (cm)  Volume:   63600.0 (cm3)  Weight:5890.00 (kg)
  Low Range:   50.0       High Range:  2000.0 m
  Accuracy:                                  Refresh Rate:
  Sensor type: phased array sodar
  Power consumption:                             Moving parts: No

------------------------------------------------------------------
```

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

Qualimetrics Inc Model: 2070-B Series Prop Anem System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 32.4 (cm)
Diameter: 3.6 (cm) Volume: 329.8 (cm3) Weight: .34 (kg)
Low Range: 0.0 High Range: 50.0 m/sec
Accuracy: Refresh Rate:
Sensor type: 4-blade propeller
Power consumption: Moving parts: Yes

Climatronics Model: WC-14 w/propeller 21282 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 76.0 (cm)
Diameter: 2.5 (cm) Volume: 385.1 (cm3) Weight: .34 (kg)
Low Range: 0.0 High Range: 27.0 m/sec
Accuracy: Refresh Rate: N/A
Sensor type: solid state photochopper
Power consumption: 6.5 - 12 VDC, 2ma Moving parts: Yes

Climatronics Model: WC-14 w/propeller 8234 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 76.0 (cm)
Diameter: 2.5 (cm) Volume: 385.1 (cm3) Weight: .34 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: Refresh Rate: N/A
Sensor type: solid state photochopper
Power consumption: 6.5 - 12 VDC, 2ma Moving parts: Yes

Scientific Sales Model: 03002 System: 01
Length: 32.0 (cm) Width: 28.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 896.0 (cm3) Weight: .70 (kg)
Low Range: 0.0 High Range: 50.0 m/sec
Accuracy: Refresh Rate:
Sensor type: 3 cup anemometer
Power consumption: 5-15 VDC Moving parts: Yes

Campbell Scientific Model: RM Young 03001 System: 01
Length: 122.0 (cm) Width: 3.8 (cm) Height: 15.0 (cm)
Diameter: 0.0 (cm) Volume: 6954.0 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 50.0 m/sec
Accuracy: Refresh Rate: N/A
Sensor type: cup anemometer
Power consumption: Regulated DC voltage, 15V Moving parts: Yes

Equipment by Requirement Category

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

Campbell Scientific Model: RM Young 05305 System: 01
Length: 38.1 (cm) Width: 65.0 (cm) Height: 15.0 (cm)
Diameter: 0.0 (cm) Volume: 2476.5 (cm3) Weight: 1.14 (kg)
Low Range: 0.0 High Range: 41.0 m/sec
Accuracy: Refresh Rate: N/A
Sensor type: 4 blade propeller
Power consumption: Supplied by data logger Moving parts: Yes

WeatherPort NovaLynx Model: WS-12 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 19.0 (cm)
Diameter: 2.5 (cm) Volume: 96.3 (cm3) Weight: 1.36 (kg)
Low Range: 0.0 High Range: 59.0 m/sec
Accuracy: Refresh Rate: real time
Sensor type: 3 Cup Anemometer
Power consumption: Moving parts: Yes

WeatherPort NovaLynx Model: WS-10T Wind Station System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 19.0 (cm)
Diameter: 2.5 (cm) Volume: 96.3 (cm3) Weight: 1.36 (kg)
Low Range: 0.0 High Range: 56.0 m/sec
Accuracy: Refresh Rate:
Sensor type: 3 Cup Anemometer
Power consumption: Gameport interface Moving parts: Yes

Young Meteor. Inst Model: 04503 System: 01
Length: 7.0 (cm) Width: 22.0 (cm) Height: 17.0 (cm)
Diameter: 0.0 (cm) Volume: 2618.0 (cm3) Weight: 1.40 (kg)
Low Range: High Range:
Accuracy: Refresh Rate: .2 sec
Sensor type:
Power consumption: 8-30 VDC or 115 VAC Moving parts: No

Campbell Scientific Model: RM Young 05103 System: 01
Length: 37.0 (cm) Width: 55.0 (cm) Height: 15.0 (cm)
Diameter: 0.0 (cm) Volume: 2035.0 (cm3) Weight: 1.45 (kg)
Low Range: 0.0 High Range: 60.0 m/sec
Accuracy: Refresh Rate: N/A
Sensor type: 4 blade propeller
Power consumption: Supplied by data logger Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

==========

Scientific Sales Model: WeatherMax System: 05
Length: 25.0 (cm) Width: 23.0 (cm) Height: 9.0 (cm)
Diameter: 0.0 (cm) Volume: 5175.0 (cm3) Weight: 2.00 (kg)
Low Range: 0.0 High Range: 114.0 m/sec
Accuracy: Refresh Rate:
Sensor type:
Power consumption: 12 VDC Moving parts: No

Scientific Sales Model: 2510 Totalizing Anemomet System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 40.6 (cm)
Diameter: 30.5 (cm) Volume: 29663.1 (cm3) Weight: 2.27 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: Refresh Rate:
Sensor type: 3 cup assembly polycarbonate
Power consumption: Moving parts: Yes

Young Meteor. Inst Model: 05401 System: 01
Length: 14.0 (cm) Width: 22.0 (cm) Height: 23.0 (cm)
Diameter: 0.0 (cm) Volume: 7084.0 (cm3) Weight: 2.30 (kg)
Low Range: 0.0 High Range: 100.0 m/sec
Accuracy: Refresh Rate: continuous
Sensor type:
Power consumption: 115 VAC Moving parts: No

Young Meteor. Inst Model: 12002/12302 System: 01
Length: 76.0 (cm) Width: 30.0 (cm) Height: 38.0 (cm)
Diameter: 0.0 (cm) Volume: 86640.0 (cm3) Weight: 2.40 (kg)
Low Range: 0.0 High Range: 32.0 m/sec
Accuracy: Refresh Rate:
Sensor type: 3 cup anemometer with EPS fin
Power consumption: 5 - 15 VDC Moving parts: Yes

Young Meteor. Inst Model: 12005/12305 System: 01
Length: 76.0 (cm) Width: 30.0 (cm) Height: 38.0 (cm)
Diameter: 0.0 (cm) Volume: 86640.0 (cm3) Weight: 2.40 (kg)
Low Range: 0.0 High Range: 50.0 m/sec
Accuracy: Refresh Rate:
Sensor type: 3 cup anemometer with aluminum fin
Power consumption: 5 - 15 VDC Moving parts: Yes

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

Young Meteor. Inst Model: 27005 GILL UVA Anem System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 43.0 (cm)
Diameter: 2.5 (cm) Volume: 211.1 (cm3) Weight: 3.60 (kg)
Low Range: 0.0 High Range: 25.0 m/sec
Accuracy: Refresh Rate:
Sensor type: UVW Anemometer with 08274 EPS propellers
Power consumption: 24 VAC Moving parts: Yes

Young Meteor. Inst Model: 27005T GILL UVA Anem System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 43.0 (cm)
Diameter: 2.5 (cm) Volume: 211.1 (cm3) Weight: 3.60 (kg)
Low Range: 0.0 High Range: 36.0 m/sec
Accuracy: Refresh Rate:
Sensor type: UVW Anemometer with 08254 CFT propellers
Power consumption: 24 VAC Moving parts: Yes

Young Meteor. Inst Model: 27106 Prop Anem System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 43.0 (cm)
Diameter: 2.5 (cm) Volume: 211.1 (cm3) Weight: 3.60 (kg)
Low Range: 0.0 High Range: 25.0 m/sec
Accuracy: Refresh Rate:
Sensor type: 4 blade propeller w/08274 EPS propellers
Power consumption: 24 VAC Moving parts: Yes

Young Meteor. Inst Model: 27106T Prop Anem System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 43.0 (cm)
Diameter: 2.5 (cm) Volume: 211.1 (cm3) Weight: 3.60 (kg)
Low Range: 0.0 High Range: 36.0 m/sec
Accuracy: Refresh Rate:
Sensor type: 4 blade propeller w/08274 CFT propellers
Power consumption: 24 VAC Moving parts: Yes

NovaLynx Model: 220-101 System: 01
Length: 38.1 (cm) Width: 65.0 (cm) Height: 5.0 (cm)
Diameter: 0.0 (cm) Volume: 12382.5 (cm3) Weight: 5.00 (kg)
Low Range: 0.0 High Range: 41.0 m/sec
Accuracy: Refresh Rate:
Sensor type: 4-blade helicoid propeller
Power consumption: Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

==========

NovaLynx Model: 220-100 System: 01
Length: 37.0 (cm) Width: 55.0 (cm) Height: 5.0 (cm)
Diameter: 0.0 (cm) Volume: 10175.0 (cm3) Weight: 5.40 (kg)
Low Range: 0.0 High Range: 59.0 m/sec
Accuracy: Refresh Rate:
Sensor type: 4-blade helicoid propeller
Power consumption: Moving parts: Yes

REMTECH Model: HPPAI System: 03
Length: 2560.0 (cm) Width: 2560.0 (cm) Height:2560.0 (cm)
Diameter: 0.0 (cm) Volume: ********* (cm3) Weight: 45.00 (kg)
Low Range: 0.0 High Range: 2250.0 m
Accuracy: Refresh Rate: N/A
Sensor type: phased array sodar
Power consumption: Moving parts: No

Vaisala Model: WAA 15A System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 24.0 (cm)
Diameter: 8.6 (cm) Volume: 1394.1 (cm3) Weight: .50 (kg)
Low Range: .4 High Range: 75.0 m/sec
Accuracy: .01 m/sec Refresh Rate:
Sensor type: optoelectronic Anemometer
Power consumption: 11..15.5 VDC Moving parts: Yes

Applied Tech. Inc Model: V style System: 02
Length: 17.8 (cm) Width: 17.8 (cm) Height: 17.8 (cm)
Diameter: 7.6 (cm) Volume: 5639.8 (cm3) Weight: .45 (kg)
Low Range: High Range:
Accuracy: .05 m/sec Refresh Rate: 10 samples/sec
Sensor type: V style sonic Array
Power consumption: 110-120V (DC opt) Moving parts: No

Applied Tech. Inc Model: K and Sx style System: 02
Length: 25.4 (cm) Width: 35.6 (cm) Height: 40.6 (cm)
Diameter: 0.0 (cm) Volume: 36712.1 (cm3) Weight: 1.00 (kg)
Low Range: High Range:
Accuracy: .05 m/sec Refresh Rate: 10 samples/sec
Sensor type: K and Sx style sonic Array
Power consumption: 110-120V (DC opt) Moving parts: No

Equipment by Requirement Category

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

Climatronics Model: Wind Monitor p/n101283G1 System: 01
Length: 7.9 (cm) Width: 25.6 (cm) Height: 38.0 (cm)
Diameter: 0.0 (cm) Volume: 7685.1 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 60.0 m/sec
Accuracy: .07 m/sec Refresh Rate: N/A
Sensor type: 4 blade helicoid propeller
Power consumption: 8-14 VDC Moving parts: Yes

Climatronics Model: F460 Wind Sensors System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 29.9 (cm)
Diameter: 5.7 (cm) Volume: 763.0 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 56.0 m/sec
Accuracy: .07 m/sec Refresh Rate: N/A
Sensor type: 3 cup anemometer assembly
Power consumption: 12 VDC Moving parts: Yes

MET ONE Model: 1564B System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 38.0 (cm)
Diameter: 7.6 (cm) Volume: 1723.9 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 41.0 m/sec
Accuracy: .07 m/sec Refresh Rate:
Sensor type: 3 cup anemometer
Power consumption: 10.5-15 VDC Moving parts: Yes

Teledyne Geotech Model: 1564B System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 38.0 (cm)
Diameter: 7.6 (cm) Volume: 1723.9 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 41.0 m/sec
Accuracy: .07 m/sec Refresh Rate:
Sensor type: 3 cup anemometer
Power consumption: 10.5-15 VDC Moving parts: Yes

NovaLynx Model: 2010 Anemometer System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 28.1 (cm)
Diameter: 17.8 (cm) Volume: 6992.6 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: .07 m/sec Refresh Rate:
Sensor type: 3 cup assembly, polycarbonite
Power consumption: 10mA, 12 VDC Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

==========

Climatronics Model: Wind Monitor p/n101283GO System: 01
Length: 37.0 (cm) Width: 55.0 (cm) Height: 18.0 (cm)
Diameter: 0.0 (cm) Volume: 36630.0 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 60.0 m/sec
Accuracy: .07 m/sec Refresh Rate: N/A
Sensor type: 4 blade helicoid propeller
Power consumption: 8-14 VDC Moving parts: Yes

Scientific Sales Model: MICRORESPONSE 2030 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.5 (cm)
Diameter: 7.0 (cm) Volume: 1173.8 (cm3) Weight: 1.10 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: .07 m/sec Refresh Rate: N/A
Sensor type: 3 cup anemometer
Power consumption: Moving parts: Yes

Scientific Sales Model: 2030 Micro Response Anem System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.5 (cm)
Diameter: 19.0 (cm) Volume: 8647.6 (cm3) Weight: 1.10 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: .07 m/sec Refresh Rate:
Sensor type: 3 Cup Anemometer
Power consumption: Moving parts: Yes

MET ONE Model: AutoMet System: 03
Length: 61.0 (cm) Width: 30.0 (cm) Height: 183.0 (cm)
Diameter: 0.0 (cm) Volume: 334890.0 (cm3) Weight: 0.00 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: .11 m/sec Refresh Rate: instantenous
Sensor type:
Power consumption: 12 VDC Int Bat Pk Moving parts: Yes

Campbell Scientific Model: Met One's 014A System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 16.0 (cm)
Diameter: 8.0 (cm) Volume: 804.0 (cm3) Weight: .40 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: .11 m/sec Refresh Rate: N/A
Sensor type: 3 cup anemometer
Power consumption: Supplied by data logger Moving parts: Yes

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

Climatronics Model: Current Loop p/n101908 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 1.0 (cm)
Diameter: 9.5 (cm) Volume: 70.9 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 56.0 m/sec
Accuracy: .11 m/sec Refresh Rate: N/A
Sensor type: 3 cup anemometer
Power consumption: 24 VDC Moving parts: Yes

Climatronics Model: Wind Mark III (100108-1) System: 00
Length: 70.0 (cm) Width: 20.0 (cm) Height: 38.0 (cm)
Diameter: 0.0 (cm) Volume: 53200.0 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 56.0 m/sec
Accuracy: .11 m/sec Refresh Rate: N/A
Sensor type: 3 cup anemometer
Power consumption: 6-12 VDC Moving parts: Yes

MET ONE Model: AutoMet 25 System: 03
Length: 20.0 (cm) Width: 20.0 (cm) Height: 20.0 (cm)
Diameter: 0.0 (cm) Volume: 8000.0 (cm3) Weight: 2.00 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: .11 m/sec Refresh Rate:
Sensor type:
Power consumption: 12 VDC, battery, solar Moving parts: Yes

Young Meteor. Inst Model: 05305 System: 01
Length: 38.1 (cm) Width: 65.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2476.5 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 41.0 m/sec
Accuracy: .18 m/sec Refresh Rate:
Sensor type: 4 blade propeller
Power consumption: 15 VDC max Moving parts: Yes

Young Meteor. Inst Model: 05701 Wind Monitor RE System: 01
Length: 38.1 (cm) Width: 65.0 (cm) Height: 5.1 (cm)
Diameter: 0.0 (cm) Volume: 12630.1 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 32.0 m/sec
Accuracy: .18 m/sec Refresh Rate:
Sensor type: 4 blade propeller
Power consumption: 15 VDC max Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

==========

Scientific Sales Model: 05350 System: 01
Length: 20.0 (cm) Width: 38.0 (cm) Height: 65.0 (cm)
Diameter: 0.0 (cm) Volume: 49400.0 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 41.0 m/sec
Accuracy: .20 m/sec Refresh Rate:
Sensor type: four blade helicoid propeller
Power consumption: 15 VDC Moving parts: Yes

NovaLynx Model: 200-05701 System: 01
Length: 65.0 (cm) Width: 38.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2470.0 (cm3) Weight: .70 (kg)
Low Range: 0.0 High Range: 32.0 m/sec
Accuracy: .20 m/sec Refresh Rate: N/A
Sensor type:
Power consumption: 15 VDC Moving parts: Yes

Climatronics Model: EWS System: 07
Length: 39.4 (cm) Width: 78.1 (cm) Height: 14.6 (cm)
Diameter: 0.0 (cm) Volume: 44926.2 (cm3) Weight: 20.00 (kg)
Low Range: 0.0 High Range: 50.0 m/sec
Accuracy: .25 m/sec Refresh Rate: N/A
Sensor type: photochopper
Power consumption: AC/DC Moving parts: Yes

Young Meteor. Inst Model: 05103 System: 01
Length: 37.0 (cm) Width: 55.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2035.0 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 60.0 m/sec
Accuracy: .27 m/sec Refresh Rate:
Sensor type: 4 blade propeller
Power consumption: 15 VDC max Moving parts: Yes

Qualimetrics Inc Model: 2300 Wind Bird System: 01
Length: 37.1 (cm) Width: 55.1 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2044.2 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 60.0 m/sec
Accuracy: .27 m/sec Refresh Rate:
Sensor type: 4-blade helicoid propeller
Power consumption: Moving parts: Yes

Equipment by Requirement Category

```
==========================================================================
Reference: 3.1.1.54a   Wind, surface, speed
      Required Accuracy: 1 Kt (.515 m/sec)
      Required Refresh Rate:   15 (min)
==========================================================================

Scientific Sales          Model: 05103                        System:  01
  Length:        37.0 (cm)  Width:        55.0 (cm)   Height:    1.0 (cm)
  Diameter:       0.0 (cm)  Volume:     2035.0 (cm3)  Weight:    1.00 (kg)
  Low Range:      0.0       High Range:     60.0 m/sec
  Accuracy:        .30 m/sec                 Refresh Rate:
  Sensor type: 4 blade helicoid propeller
  Power consumption: 15 VDC                       Moving parts: Yes


Scientific Sales          Model: Wind Monitor-JR              System:  01
  Length:        33.0 (cm)  Width:        31.0 (cm)   Height:    1.0 (cm)
  Diameter:       0.0 (cm)  Volume:     1023.0 (cm3)  Weight:     .45 (kg)
  Low Range:      0.0       High Range:     60.0 m/sec
  Accuracy:        .45 m/sec                 Refresh Rate:
  Sensor type: 4 blade propeller
  Power consumption: 15 VDC                       Moving parts: Yes


Climatronics              Model: TACMET                       System:  03
  Length:         0.0 (cm)  Width:         0.0 (cm)   Height:   32.4 (cm)
  Diameter:      10.2 (cm)  Volume:     2647.5 (cm3)  Weight:     .77 (kg)
  Low Range:      0.0       High Range:     45.0 m/sec
  Accuracy:        .45 m/sec                 Refresh Rate: N/A
  Sensor type: IREMBAS COTS Wx Mod 3 cup polycarb plast
  Power consumption: 12 VDC @ 10mA                Moving parts: Yes


NovaLynx                  Model: 110-WS-10T Wind Station  System:  02
  Length:        46.0 (cm)  Width:        61.0 (cm)   Height:   46.0 (cm)
  Diameter:       0.0 (cm)  Volume:     5612.0 (cm3)  Weight:    1.10 (kg)
  Low Range:      0.0       High Range:     56.0 m/sec
  Accuracy:        .45 m/sec                 Refresh Rate: 1.5 sec
  Sensor type:
  Power consumption: Gameport Interface           Moving parts: Yes


NovaLynx                  Model: 110-WS-12 Wind Station   System:  02
  Length:         9.7 (cm)  Width:        16.0 (cm)   Height:    3.6 (cm)
  Diameter:       0.0 (cm)  Volume:      558.7 (cm3)  Weight:    1.36 (kg)
  Low Range:      0.0       High Range:     60.0 m/sec
  Accuracy:        .45 m/sec                 Refresh Rate:
  Sensor type:
  Power consumption: Parallel Port Interface      Moving parts: Yes
```

==========

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

==========

WeatherPort NovaLynx Model: WS-21 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 7.6 (cm)
Diameter: 2.5 (cm) Volume: 38.5 (cm3) Weight: 2.30 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: .45 m/sec Refresh Rate: 2 sec
Sensor type: 3 Cup Anemometer
Power consumption: 12-24 VAC or DC Moving parts: Yes

EASI Model: EZ160/EZ162 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.0 (cm)
Diameter: 15.0 (cm) Volume: 5301.0 (cm3) Weight: 5.00 (kg)
Low Range: 0.0 High Range: 90.0 m/sec
Accuracy: .45 m/sec Refresh Rate: N/A
Sensor type: flat vane
Power consumption: 12V DC 60mA Moving parts: Yes

Qualimetrics Inc Model: 2100 Skyvane series System: 01
Length: 76.2 (cm) Width: 75.6 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 5760.7 (cm3) Weight: 5.40 (kg)
Low Range: 0.0 High Range: 56.0 m/sec
Accuracy: .45 m/sec Refresh Rate: continuous
Sensor type: 4-blade propeller
Power consumption: Moving parts: Yes

Scientific Sales Model: 2100 Skyvane series System: 01
Length: 76.2 (cm) Width: 75.6 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 5760.7 (cm3) Weight: 5.45 (kg)
Low Range: 0.0 High Range: 56.0 m/sec
Accuracy: .45 m/sec Refresh Rate: continuous
Sensor type: 4-blade propeller
Power consumption: 115 or 230 VAC Moving parts: Yes

MET ONE Model: WS-201 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 23.5 (cm)
Diameter: 2.4 (cm) Volume: 106.3 (cm3) Weight: .50 (kg)
Low Range: 0.0 High Range: 41.0 m/sec
Accuracy: .50 m/sec Refresh Rate:
Sensor type:
Power consumption: 6mA at 10.5-15VDC Moving parts: Yes

Equipment by Requirement Category

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

Handar Model: 456A System: 01
Length: 28.0 (cm) Width: 12.0 (cm) Height: 32.0 (cm)
Diameter: 0.0 (cm) Volume: 10752.0 (cm3) Weight: 1.40 (kg)
Low Range: 0.0 High Range: 50.0 m/sec
Accuracy: .50 m/sec Refresh Rate:
Sensor type: 3 Cup Anemometer
Power consumption: 5 - 15 VDC Moving parts: Yes

NovaLynx Model: TFV4056 System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 32.0 (cm)
Diameter: 10.5 (cm) Volume: 2770.9 (cm3) Weight: 2.20 (kg)
Low Range: 0.0 High Range: 50.0 m/sec
Accuracy: .50 m/sec Refresh Rate: 10 msec
Sensor type:
Power consumption: 24 VDC Moving parts: No

MesoTech Internation Model: NBC 5056 Auto WX Station System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 55.0 (cm)
Diameter: 8.0 (cm) Volume: 2764.6 (cm3) Weight: 3.20 (kg)
Low Range: 0.0 High Range: 60.0 m/sec
Accuracy: .50 m/sec Refresh Rate: 10 msec
Sensor type:
Power consumption: 24 VDC opt power supply Moving parts: No

EASI Model: EZ161 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 24.0 (cm)
Diameter: 4.8 (cm) Volume: 434.3 (cm3) Weight: .30 (kg)
Low Range: 0.0 High Range: 99.0 scale
Accuracy: .51 m/sec Refresh Rate:
Sensor type: digital hand held anemometer
Power consumption: battery powered Moving parts: Yes

NovaLynx Model: 2056 Anem Serial Wind Sy System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.5 (cm)
Diameter: 7.0 (cm) Volume: 1173.8 (cm3) Weight: .45 (kg)
Low Range: 0.0 High Range: 64.0 m/sec
Accuracy: .80 m/sec Refresh Rate:
Sensor type: 3 cup assembly
Power consumption: 115 VAC Moving parts: Yes

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

NovaLynx Model: 5050WS System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 7.5 (cm)
Diameter: 2.5 (cm) Volume: 38.0 (cm3) Weight: .45 (kg)
Low Range: 0.0 High Range: 68.0 m/sec
Accuracy: 1.00 % Refresh Rate:
Sensor type:
Power consumption: Moving parts: Yes

Scientific Sales Model: 220-310 Tot Anemometer System: 00
Length: 16.5 (cm) Width: 11.4 (cm) Height: 6.3 (cm)
Diameter: 0.0 (cm) Volume: 1198.3 (cm3) Weight: .45 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: 1.00 % Refresh Rate:
Sensor type: 3 Cup Anemometer
Power consumption: Moving parts: Yes

MET ONE Model: 010B System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.0 (cm)
Diameter: 15.0 (cm) Volume: 5301.0 (cm3) Weight: .45 (kg)
Low Range: 0.0 High Range: 56.0 m/sec
Accuracy: 1.00 % Refresh Rate: N/A
Sensor type:
Power consumption: Moving parts: Yes

Climatronics Model: METRAC System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 83.3 (cm)
Diameter: 10.0 (cm) Volume: 6542.4 (cm3) Weight: 5.00 (kg)
Low Range: 0.0 High Range: 30.0 m/sec
Accuracy: 1.00 m/sec Refresh Rate: N/A
Sensor type: IREMBAS COTS Wx Module
Power consumption: 12 V or rechargeable bat. Moving parts: Yes

TX Electronics Inc Model: 446A System: 01
Length: 85.4 (cm) Width: 33.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2818.2 (cm3) Weight: 11.36 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: 1.00 % Refresh Rate: 1 sec
Sensor type: 3 Cup Anemometer
Power consumption: 120 V 60 Hz opt 12 VDC Moving parts: Yes

==========

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

==========

METOCEAN Model: Ice Beacon System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 31.0 (cm)
Diameter: 54.0 (cm) Volume: 70997.0 (cm3) Weight: 20.00 (kg)
Low Range: 0.0 High Range: 60.0 m/sec
Accuracy: 1.00 m/sec Refresh Rate:
Sensor type: Data sent to ARGOS
Power consumption: 5 - 17.6 V battery Moving parts: Yes

METOCEAN Model: Standard Drifter System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 350.0 (cm)
Diameter: 69.0 (cm) Volume: 1308751.3 (cm3) Weight: 95.00 (kg)
Low Range: 0.0 High Range: 63.0 m/sec
Accuracy: 1.00 m/sec Refresh Rate:
Sensor type: (TIROS/ARGOS)
Power consumption: Alkaline Bat (5-17.6V) Moving parts: No

Handar Model: 453AQ System: 01
Length: 38.0 (cm) Width: 65.0 (cm) Height: 20.0 (cm)
Diameter: 0.0 (cm) Volume: 49400.0 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 41.0 m/sec
Accuracy: 1.80 m/sec Refresh Rate:
Sensor type: 4 blade propeller
Power consumption: 5 - 15 VDC Moving parts: Yes

TX Electronics Inc Model: TV-110-L2 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 19.0 (cm)
Diameter: 45.7 (cm) Volume: 31165.7 (cm3) Weight: 1.70 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: 2.00 % Refresh Rate:
Sensor type: 3 or 6 cup anemometer
Power consumption: 5-8 VDC Moving parts: Yes

TX Electronics Inc Model: TV-114 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 19.0 (cm)
Diameter: 45.7 (cm) Volume: 31165.7 (cm3) Weight: 1.70 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: 2.00 % Refresh Rate:
Sensor type: 3 or 6 cup anemometer
Power consumption: self-generating Moving parts: Yes

Equipment by Requirement Category

```
=====================================================================
Reference: 3.1.1.54a   Wind, surface, speed
      Required Accuracy: 1 Kt (.515 m/sec)
      Required Refresh Rate:   15 (min)
=====================================================================

Scientific Sales        Model: WS-21                      System:  00
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   7.6 (cm)
  Diameter:     12.7 (cm)  Volume:     962.7 (cm3)  Weight:   2.30 (kg)
  Low Range:     0.0       High Range:    45.0 m/sec
  Accuracy:      2.00 %                    Refresh Rate:
  Sensor type: 3 Cup Anemometer
  Power consumption: 12-24 VAC or DC           Moving parts: Yes


TX Wx Inst Inc          Model: Weather Report System    System:  03
  Length:       31.0 (cm)  Width:       15.2 (cm)   Height:   8.9 (cm)
  Diameter:      0.0 (cm)  Volume:    4193.7 (cm3)  Weight:  22.50 (kg)
  Low Range:     0.0       High Range:    56.0 m/sec
  Accuracy:      2.00 %                    Refresh Rate: instantenous
  Sensor type: 3 cup anemometer
  Power consumption: RS 232 adapter            Moving parts: Yes


Weather Port            Model: Weather Report WR-25/C   System:  03
  Length:       31.0 (cm)  Width:       15.2 (cm)   Height:   8.9 (cm)
  Diameter:      0.0 (cm)  Volume:    4193.7 (cm3)  Weight:  22.50 (kg)
  Low Range:     0.0       High Range:    56.0 m/sec
  Accuracy:      2.00 %                    Refresh Rate:
  Sensor type:
  Power consumption:                           Moving parts: No


Weather Port            Model: Weather Report WR-25/S   System:  06
  Length:       31.0 (cm)  Width:       15.2 (cm)   Height:   8.9 (cm)
  Diameter:      0.0 (cm)  Volume:    4193.7 (cm3)  Weight:  22.50 (kg)
  Low Range:     0.0       High Range:    56.0 m/sec
  Accuracy:      2.00 %                    Refresh Rate:
  Sensor type:
  Power consumption:                           Moving parts: No


Handar                  Model: 453/453A                   System:  01
  Length:       37.0 (cm)  Width:       55.0 (cm)   Height:  18.0 (cm)
  Diameter:      0.0 (cm)  Volume:   36630.0 (cm3)  Weight:   1.00 (kg)
  Low Range:     0.0       High Range:    60.0 m/sec
  Accuracy:      2.70 m/sec                Refresh Rate:
  Sensor type: 4 blade propeller
  Power consumption: 5 - 15 VDC                Moving parts: Yes
```

Equipment by Requirement Category

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

Qualimetrics Inc Model: 2132 Combo Wind Sensor System: 01
Length: 15.9 (cm) Width: 40.6 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 645.5 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: 3.00 % Refresh Rate:
Sensor type: 3 Cup Anemometer
Power consumption: Moving parts: Yes

Qualimetrics Inc Model: 2133 Windicator Ind Wind System: 01
Length: 15.9 (cm) Width: 40.6 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 645.5 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: 3.00 % Refresh Rate:
Sensor type: 3 Cup Anemometer
Power consumption: none Moving parts: Yes

NovaLynx Model: 2612 Anemometer System: 00
Length: 20.3 (cm) Width: 16.2 (cm) Height: 6.4 (cm)
Diameter: 0.0 (cm) Volume: 2104.7 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: 3.00 % Refresh Rate:
Sensor type: 3 cup assembly
Power consumption: Moving parts: Yes

NovaLynx Model: 2615 Wind Minder System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 15.2 (cm)
Diameter: 19.7 (cm) Volume: 4633.0 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 45.0 m/sec
Accuracy: 3.00 % Refresh Rate:
Sensor type: 3 cup assembly
Power consumption: AC generator 0-10 VAC Moving parts: Yes

WeatherPort NovaLynx Model: WS-22 Wind Station System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 7.6 (cm)
Diameter: 2.5 (cm) Volume: 38.5 (cm3) Weight: 2.30 (kg)
Low Range: 0.0 High Range: 59.0 m/sec
Accuracy: 3.00 % Refresh Rate: 2.1 sec
Sensor type: 3 Cup Anemometer
Power consumption: 10-48 VDC Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

==========

Handar Model: 430A/B System: 00
Length: 39.4 (cm) Width: 10.4 (cm) Height: 2.5 (cm)
Diameter: 0.0 (cm) Volume: 1024.4 (cm3) Weight: .45 (kg)
Low Range: 0.0 High Range: 68.0 m/sec
Accuracy: 5.00 % Refresh Rate:
Sensor type: 3 Cup Anemometer
Power consumption: 10 - 15 V Moving parts: Yes

TX Electronics Inc Model: TV-110-L3 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 16.5 (cm)
Diameter: 8.9 (cm) Volume: 1026.5 (cm3) Weight: .45 (kg)
Low Range: 0.0 High Range: 50.0 m/sec
Accuracy: 5.00 % Refresh Rate:
Sensor type: Anemometer
Power consumption: min 3 VDC Moving parts: Yes

Davis Instruments Model: Weather Monitor II System: 05
Length: 13.3 (cm) Width: 14.9 (cm) Height: 7.7 (cm)
Diameter: 0.0 (cm) Volume: 1525.9 (cm3) Weight: .50 (kg)
Low Range: 0.0 High Range: 79.0 m/s
Accuracy: 5.00 % Refresh Rate: N/A
Sensor type: 3 cup anemometer
Power consumption: AC with battery backup Moving parts: Yes

Davis Instruments Model: Weather Wizard III System: 04
Length: 13.3 (cm) Width: 14.9 (cm) Height: 7.7 (cm)
Diameter: 0.0 (cm) Volume: 1525.9 (cm3) Weight: .50 (kg)
Low Range: 0.0 High Range: 79.0 m/s
Accuracy: 5.00 % Refresh Rate: N/A
Sensor type:
Power consumption: AC with battery backup Moving parts: Yes

Qualimetrics Inc Model: 9000 TAMS System: 04
Length: 22.9 (cm) Width: 9.5 (cm) Height: 4.3 (cm)
Diameter: 0.0 (cm) Volume: 935.5 (cm3) Weight: .90 (kg)
Low Range: 1.0 High Range: 26.0 m/sec
Accuracy: 5.00 % Refresh Rate:
Sensor type:
Power consumption: 6-12 AA, DC, Lith bat Moving parts: Yes

Equipment by Requirement Category

Reference: 3.1.1.54a Wind, surface, speed
Required Accuracy: 1 Kt (.515 m/sec)
Required Refresh Rate: 15 (min)

Scientific Sales Model: 9000 Mobile-Met System: 05
Length: 33.0 (cm) Width: 25.4 (cm) Height: 15.2 (cm)
Diameter: 0.0 (cm) Volume: 12740.6 (cm3) Weight: 3.60 (kg)
Low Range: .5 High Range: 26.0 m/sec
Accuracy: 5.00 % Refresh Rate:
Sensor type:
Power consumption: 6-12 AA, 12-18 VDC Moving parts: Yes

Scientific Sales Model: WST7000 Weather Station System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 40.0 (cm)
Diameter: 10.5 (cm) Volume: 3463.6 (cm3) Weight: 2.20 (kg)
Low Range: 0.0 High Range: 50.0 m/sec
Accuracy: 9.50 m/sec Refresh Rate: 10 msec
Sensor type: Thermal Field Variation technique
Power consumption: 24 VDC Moving parts: No

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

Campbell Scientific Model: RM Young 03101 System: 00
Length: 7.6 (cm) Width: 3.8 (cm) Height: 15.0 (cm)
Diameter: 0.0 (cm) Volume: 433.0 (cm3) Weight: .17 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: Refresh Rate: N/A
Sensor type: potentiometer
Power consumption: Regulated DC voltage, 15V Moving parts: Yes

Scientific Sales Model: 03002 System: 02
Length: 32.0 (cm) Width: 28.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 896.0 (cm3) Weight: .70 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: Refresh Rate:
Sensor type: vane
Power consumption: 5-15 VDC Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

==========

Campbell Scientific Model: RM Young 03001 System: 02
Length: 122.0 (cm) Width: 3.8 (cm) Height: 15.0 (cm)
Diameter: 0.0 (cm) Volume: 6954.0 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: Refresh Rate: N/A
Sensor type: potentiometer
Power consumption: Regulated DC voltage, 15V Moving parts: Yes

NovaLynx Model: 110-WS-10T Wind Station System: 03
Length: 46.0 (cm) Width: 61.0 (cm) Height: 46.0 (cm)
Diameter: 0.0 (cm) Volume: 5612.0 (cm3) Weight: 1.10 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: Refresh Rate: 1.5 sec
Sensor type:
Power consumption: Gameport Interface Moving parts: Yes

Campbell Scientific Model: RM Young 05305 System: 02
Length: 38.1 (cm) Width: 65.0 (cm) Height: 15.0 (cm)
Diameter: 0.0 (cm) Volume: 2476.5 (cm3) Weight: 1.14 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: Refresh Rate: N/A
Sensor type: potentiometer
Power consumption: Supplied by data logger Moving parts: Yes

WeatherPort NovaLynx Model: WS-10T Wind Station System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 19.0 (cm)
Diameter: 2.5 (cm) Volume: 96.3 (cm3) Weight: 1.36 (kg)
Low Range: High Range:
Accuracy: Refresh Rate: 1.5 sec
Sensor type:
Power consumption: Gameport interface Moving parts: Yes

Young Meteor. Inst Model: 04503 System: 02
Length: 7.0 (cm) Width: 22.0 (cm) Height: 17.0 (cm)
Diameter: 0.0 (cm) Volume: 2618.0 (cm3) Weight: 1.40 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: Refresh Rate: 1 sec
Sensor type:
Power consumption: 8-30 VDC or 115 VAC Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

==========

Campbell Scientific Model: RM Young 05103 System: 02
Length: 37.0 (cm) Width: 55.0 (cm) Height: 15.0 (cm)
Diameter: 0.0 (cm) Volume: 2035.0 (cm3) Weight: 1.45 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: Refresh Rate: N/A
Sensor type: potentiometer
Power consumption: Supplied by data logger Moving parts: Yes

Scientific Sales Model: WeatherMax System: 06
Length: 25.0 (cm) Width: 23.0 (cm) Height: 9.0 (cm)
Diameter: 0.0 (cm) Volume: 5175.0 (cm3) Weight: 2.00 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type:
Power consumption: 12 VDC Moving parts: No

Young Meteor. Inst Model: 05401 System: 02
Length: 14.0 (cm) Width: 22.0 (cm) Height: 23.0 (cm)
Diameter: 0.0 (cm) Volume: 7084.0 (cm3) Weight: 2.30 (kg)
Low Range: 0.0 High Range: 36.0 points
Accuracy: Refresh Rate: continuous
Sensor type:
Power consumption: 115 VAC Moving parts: No

Young Meteor. Inst Model: 12002/12302 System: 02
Length: 76.0 (cm) Width: 30.0 (cm) Height: 38.0 (cm)
Diameter: 0.0 (cm) Volume: 86640.0 (cm3) Weight: 2.40 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: Refresh Rate:
Sensor type: MicroVane with EPS fin
Power consumption: 5 - 15 VDC Moving parts: Yes

Young Meteor. Inst Model: 12005/12305 System: 02
Length: 76.0 (cm) Width: 30.0 (cm) Height: 38.0 (cm)
Diameter: 0.0 (cm) Volume: 86640.0 (cm3) Weight: 2.40 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: Refresh Rate:
Sensor type: MicroVane with aluminum fin
Power consumption: 5 - 15 VDC Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

==========

NovaLynx Model: 220-101 System: 02
Length: 38.1 (cm) Width: 65.0 (cm) Height: 5.0 (cm)
Diameter: 0.0 (cm) Volume: 12382.5 (cm3) Weight: 5.00 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: Refresh Rate:
Sensor type: balanced vane
Power consumption: Moving parts: Yes

NovaLynx Model: 220-100 System: 02
Length: 37.0 (cm) Width: 55.0 (cm) Height: 5.0 (cm)
Diameter: 0.0 (cm) Volume: 10175.0 (cm3) Weight: 5.40 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: Refresh Rate:
Sensor type: balanced vane
Power consumption: Moving parts: Yes

Weather Port Model: Weather Report WR-25/C System: 04
Length: 31.0 (cm) Width: 15.2 (cm) Height: 8.9 (cm)
Diameter: 0.0 (cm) Volume: 4193.7 (cm3) Weight: 22.50 (kg)
Low Range: 0.0 High Range: 16.0 points
Accuracy: Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

Weather Port Model: Weather Report WR-25/S System: 07
Length: 31.0 (cm) Width: 15.2 (cm) Height: 8.9 (cm)
Diameter: 0.0 (cm) Volume: 4193.7 (cm3) Weight: 22.50 (kg)
Low Range: 0.0 High Range: 16.0 points
Accuracy: Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

Applied Tech. Inc Model: V style System: 03
Length: 17.8 (cm) Width: 17.8 (cm) Height: 17.8 (cm)
Diameter: 7.6 (cm) Volume: 5639.8 (cm3) Weight: .45 (kg)
Low Range: High Range:
Accuracy: .10 deg Refresh Rate: 10 samples/sec
Sensor type: V style sonic Array
Power consumption: 110-120V (DC opt) Moving parts: No

==========

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

==========

Applied Tech. Inc Model: K and Sx style System: 03
Length: 25.4 (cm) Width: 35.6 (cm) Height: 40.6 (cm)
Diameter: 0.0 (cm) Volume: 36712.1 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: .10 deg Refresh Rate: 10 samples/sec
Sensor type: K and Sx style sonic Array
Power consumption: 110-120V (DC opt) Moving parts: No

NovaLynx Model: 5050WD System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 7.5 (cm)
Diameter: 2.5 (cm) Volume: 38.0 (cm3) Weight: .23 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 1.00 % Refresh Rate:
Sensor type:
Power consumption: Moving parts: Yes

EASI Model: EZ160/EZ164 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.0 (cm)
Diameter: 15.0 (cm) Volume: 5301.0 (cm3) Weight: 5.00 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 1.00 deg Refresh Rate: N/A
Sensor type: flat vane
Power consumption: 12V DC 60mA Moving parts: Yes

TX Electronics Inc Model: 446A System: 02
Length: 85.4 (cm) Width: 33.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2818.2 (cm3) Weight: 11.36 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 1.00 % Refresh Rate: 1 sec
Sensor type: rotating vane
Power consumption: 120 V 60 Hz opt 12 VDC Moving parts: Yes

Climatronics Model: Wind Monitor p/n101283G1 System: 02
Length: 7.9 (cm) Width: 25.6 (cm) Height: 38.0 (cm)
Diameter: 0.0 (cm) Volume: 7685.1 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 2.00 deg Refresh Rate: N/A
Sensor type: vane
Power consumption: 8-14 VDC Moving parts: Yes

==========

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

==========

Climatronics Model: TACMET System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 32.4 (cm)
Diameter: 10.2 (cm) Volume: 2647.5 (cm3) Weight: .77 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 2.00 deg Refresh Rate: N/A
Sensor type: IREMBAS COTS Wx Mod counter bal alm magn
Power consumption: 12 VDC @ 10mA Moving parts: Yes

Climatronics Model: F460 Wind Sensors System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 29.9 (cm)
Diameter: 5.7 (cm) Volume: 763.0 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 2.00 deg Refresh Rate: N/A
Sensor type: vane and potentiometer
Power consumption: 12 VDC Moving parts: Yes

MET ONE Model: 1565C System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 38.0 (cm)
Diameter: 7.6 (cm) Volume: 1723.9 (cm3) Weight: .90 (kg)
Low Range: High Range:
Accuracy: 2.00 deg Refresh Rate:
Sensor type: vane
Power consumption: 10.5-15 VDC Moving parts: Yes

Teledyne Geotech Model: 1565C System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 38.0 (cm)
Diameter: 7.6 (cm) Volume: 1723.9 (cm3) Weight: .90 (kg)
Low Range: High Range:
Accuracy: 2.00 deg Refresh Rate:
Sensor type: vane
Power consumption: 10.5-15 VDC Moving parts: Yes

Climatronics Model: Wind Monitor p/n101283GO System: 02
Length: 37.0 (cm) Width: 55.0 (cm) Height: 18.0 (cm)
Diameter: 0.0 (cm) Volume: 36630.0 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 2.00 deg Refresh Rate: N/A
Sensor type: vane
Power consumption: 8-14 VDC Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

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Scientific Sales Model: MICRORESPONSE 2020 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.5 (cm)
Diameter: 7.0 (cm) Volume: 1173.8 (cm3) Weight: 1.10 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 2.00 deg Refresh Rate: N/A
Sensor type: counterbalanced tail
Power consumption: Moving parts: Yes

Qualimetrics Inc Model: 2020 Micro Response Vane System: 00
Length: 121.9 (cm) Width: 15.3 (cm) Height: 2.5 (cm)
Diameter: 0.0 (cm) Volume: 4737.3 (cm3) Weight: 1.60 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 2.00 deg Refresh Rate:
Sensor type: Counterbalanced tail
Power consumption: Moving parts: Yes

Scientific Sales Model: 2020 Micro Response Vane System: 00
Length: 121.9 (cm) Width: 15.3 (cm) Height: 2.5 (cm)
Diameter: 0.0 (cm) Volume: 4737.3 (cm3) Weight: 1.60 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 2.00 deg Refresh Rate:
Sensor type: Counterbalanced tail
Power consumption: Moving parts: Yes

NovaLynx Model: 2005 Wind Vane System: 00
Length: 40.6 (cm) Width: 56.1 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2277.7 (cm3) Weight: 1.80 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 2.00 deg Refresh Rate:
Sensor type: counterbalance tail
Power consumption: Moving parts: Yes

Qualimetrics Inc Model: 2100 Skyvane series System: 02
Length: 76.2 (cm) Width: 75.6 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 5760.7 (cm3) Weight: 5.40 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 2.00 deg Refresh Rate: continuous
Sensor type: counterbalanced tail
Power consumption: Moving parts: Yes

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

Scientific Sales Model: 2100 Skyvane series System: 02
Length: 76.2 (cm) Width: 75.6 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 5760.7 (cm3) Weight: 5.45 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 2.00 deg Refresh Rate: continuous
Sensor type: counterbalanced tail
Power consumption: 115 or 230 VAC Moving parts: Yes

Vaisala Model: WAV 15A System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.0 (cm)
Diameter: 8.6 (cm) Volume: 1742.6 (cm3) Weight: .58 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 2.80 % Refresh Rate:
Sensor type: optoelectronic wind vane
Power consumption: 11..15.5 VDC Moving parts: Yes

MET ONE Model: AutoMet System: 04
Length: 61.0 (cm) Width: 30.0 (cm) Height: 183.0 (cm)
Diameter: 0.0 (cm) Volume: 334890.0 (cm3) Weight: 0.00 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate: instantenous
Sensor type:
Power consumption: 12 VDC Int Bat Pk Moving parts: Yes

MET ONE Model: 020B System: 00
Length: 15.0 (cm) Width: 2.5 (cm) Height: 30.0 (cm)
Diameter: 0.0 (cm) Volume: 1125.0 (cm3) Weight: .45 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate: N/A
Sensor type:
Power consumption: Moving parts: Yes

NovaLynx Model: 2055 Vane Serial Wind Sy System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.5 (cm)
Diameter: 7.0 (cm) Volume: 1173.8 (cm3) Weight: .45 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate:
Sensor type: counterbalanced flat plate tail
Power consumption: 115 VAC Moving parts: Yes

==========

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

==========

TX Electronics Inc Model: TD 106 System: 00
Length: 47.9 (cm) Width: 22.2 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 1063.4 (cm3) Weight: .57 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate:
Sensor type: wind vane and hybrid potentiometer
Power consumption: min 3 VDC Moving parts: Yes

Young Meteor. Inst Model: 05305 System: 02
Length: 38.1 (cm) Width: 65.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2476.5 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate:
Sensor type: potentiometer
Power consumption: 15 VDC max Moving parts: Yes

Young Meteor. Inst Model: 05701 Wind Monitor RE System: 02
Length: 38.1 (cm) Width: 65.0 (cm) Height: 5.1 (cm)
Diameter: 0.0 (cm) Volume: 12630.1 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate:
Sensor type: potentiometer
Power consumption: 15 VDC max Moving parts: Yes

Handar Model: 453AQ System: 02
Length: 38.0 (cm) Width: 65.0 (cm) Height: 20.0 (cm)
Diameter: 0.0 (cm) Volume: 49400.0 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate:
Sensor type: vane
Power consumption: 5 - 15 VDC Moving parts: Yes

Scientific Sales Model: 05350 System: 02
Length: 20.0 (cm) Width: 38.0 (cm) Height: 65.0 (cm)
Diameter: 0.0 (cm) Volume: 49400.0 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate:
Sensor type: lightweight vane
Power consumption: 15 VDC Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

==========

NovaLynx Model: 200-05701 System: 02
Length: 65.0 (cm) Width: 38.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2470.0 (cm3) Weight: .70 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate: N/A
Sensor type:
Power consumption: 15 VDC Moving parts: Yes

Climatronics Model: Current Loop p/n101908 System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 1.0 (cm)
Diameter: 9.5 (cm) Volume: 70.9 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate: N/A
Sensor type: vane
Power consumption: 24 VDC Moving parts: Yes

Climatronics Model: Wind Mark III (100108-2) System: 00
Length: 70.0 (cm) Width: 20.0 (cm) Height: 38.0 (cm)
Diameter: 0.0 (cm) Volume: 53200.0 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate: N/A
Sensor type: vane and potentiometer
Power consumption: 6-12 VDC Moving parts: Yes

Scientific Sales Model: 05103 System: 02
Length: 37.0 (cm) Width: 55.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2035.0 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate:
Sensor type: vane
Power consumption: 15 VDC Moving parts: Yes

Young Meteor. Inst Model: 05103 System: 02
Length: 37.0 (cm) Width: 55.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2035.0 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate:
Sensor type: potentiometer
Power consumption: 15 VDC max Moving parts: Yes

==========

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

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Qualimetrics Inc Model: 2300 Wind Bird System: 02
Length: 37.1 (cm) Width: 55.1 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2044.2 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 355.0 deg
Accuracy: 3.00 deg Refresh Rate:
Sensor type: Counterbalanced tail
Power consumption: Moving parts: Yes

Handar Model: 453/453A System: 02
Length: 37.0 (cm) Width: 55.0 (cm) Height: 18.0 (cm)
Diameter: 0.0 (cm) Volume: 36630.0 (cm3) Weight: 1.00 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate:
Sensor type: vane
Power consumption: 5 - 15 VDC Moving parts: Yes

Scientific Sales Model: WST7000 Weather Station System: 05
Length: 0.0 (cm) Width: 0.0 (cm) Height: 40.0 (cm)
Diameter: 10.5 (cm) Volume: 3463.6 (cm3) Weight: 2.20 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate: 10 msec
Sensor type: Thermal Field Variation technique
Power consumption: 24 VDC Moving parts: No

MesoTech Internation Model: NBC 5056 Auto WX Station System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 55.0 (cm)
Diameter: 8.0 (cm) Volume: 2764.6 (cm3) Weight: 3.20 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.00 deg Refresh Rate: 10 msec
Sensor type:
Power consumption: 24 VDC opt power supply Moving parts: No

Climatronics Model: EWS System: 08
Length: 39.4 (cm) Width: 78.1 (cm) Height: 14.6 (cm)
Diameter: 0.0 (cm) Volume: 44926.2 (cm3) Weight: 20.00 (kg)
Low Range: 0.0 High Range: 540.0 deg
Accuracy: 3.00 deg Refresh Rate: N/A
Sensor type: potentiometer
Power consumption: Moving parts: Yes

Equipment by Requirement Category

==========

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

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MET ONE Model: WS-201 System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 23.5 (cm)
Diameter: 2.4 (cm) Volume: 106.3 (cm3) Weight: .50 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 3.60 deg Refresh Rate:
Sensor type:
Power consumption: 6mA at 10.5-15VDC Moving parts: Yes

Campbell Scientific Model: Met One's 024A System: 00
Length: 16.0 (cm) Width: 1.0 (cm) Height: 16.0 (cm)
Diameter: 0.0 (cm) Volume: 256.0 (cm3) Weight: .45 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 5.00 deg Refresh Rate: N/A
Sensor type: wire-wound potentiometer amd vane
Power consumption: Supplied by data logger Moving parts: Yes

Qualimetrics Inc Model: 2132 Combo Wind Sensor System: 02
Length: 15.9 (cm) Width: 40.6 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 645.5 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 5.00 % Refresh Rate:
Sensor type: counterbalanced air foil
Power consumption: Moving parts: Yes

Qualimetrics Inc Model: 2133 Windicator Ind Wind System: 02
Length: 15.9 (cm) Width: 40.6 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 645.5 (cm3) Weight: .68 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 5.00 % Refresh Rate:
Sensor type: counterbalanced air foil
Power consumption: none Moving parts: Yes

Qualimetrics Inc Model: 9000 TAMS System: 05
Length: 22.9 (cm) Width: 9.5 (cm) Height: 4.3 (cm)
Diameter: 0.0 (cm) Volume: 935.5 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 5.00 deg Refresh Rate:
Sensor type:
Power consumption: 6-12 AA, DC, Lith bat Moving parts: Yes

==========

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

==========

Handar Model: 431A/B System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 15.0 (cm)
Diameter: 50.0 (cm) Volume: 9818.0 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 5.00 deg Refresh Rate:
Sensor type: Vane/Potentiometer
Power consumption: LOW Moving parts: Yes

WeatherPort NovaLynx Model: WS-12 System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 19.0 (cm)
Diameter: 2.5 (cm) Volume: 96.3 (cm3) Weight: 1.36 (kg)
Low Range: High Range:
Accuracy: 5.00 deg Refresh Rate: real time
Sensor type: Wind Vane
Power consumption: Moving parts: Yes

Handar Model: 456A System: 02
Length: 28.0 (cm) Width: 12.0 (cm) Height: 32.0 (cm)
Diameter: 0.0 (cm) Volume: 10752.0 (cm3) Weight: 1.40 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 5.00 deg Refresh Rate:
Sensor type: vane
Power consumption: 5 - 15 VDC Moving parts: Yes

TX Electronics Inc Model: TD 104D System: 00
Length: 85.7 (cm) Width: 33.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 2828.1 (cm3) Weight: 1.59 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 5.00 % Refresh Rate:
Sensor type: wind vane and hybrid potentiometer
Power consumption: 5-8 VDC Moving parts: Yes

MET ONE Model: AutoMet 25 System: 04
Length: 20.0 (cm) Width: 20.0 (cm) Height: 20.0 (cm)
Diameter: 0.0 (cm) Volume: 8000.0 (cm3) Weight: 2.00 (kg)
Low Range: 0.0 High Range: 360.0 DEG
Accuracy: 5.00 deg Refresh Rate:
Sensor type:
Power consumption: 12 VDC, battery, solar Moving parts: Yes

Equipment by Requirement Category

```
======================================================================
Reference: 3.1.1.54b   Wind, surface, direction
      Required Accuracy: 10 deg
      Required Refresh Rate:   15 (min)
======================================================================

NovaLynx                  Model: TFV4056                  System:  05
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  32.0 (cm)
  Diameter:    10.5 (cm)  Volume:    2770.9 (cm3)  Weight:   2.20 (kg)
  Low Range:    0.0       High Range:   360.0 deg
  Accuracy:     5.00 deg                  Refresh Rate: 10 msec
  Sensor type:
  Power consumption: 24 VDC                     Moving parts: No


WeatherPort NovaLynx   Model: WS-22 Wind Station      System:  02
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:   7.6 (cm)
  Diameter:     2.5 (cm)  Volume:      38.5 (cm3)  Weight:   2.30 (kg)
  Low Range:    0.0       High Range:   360.0 deg
  Accuracy:     5.00 deg                  Refresh Rate: 2.1 sec
  Sensor type: Wind vane
  Power consumption: 10-48 VDC                  Moving parts: Yes


Scientific Sales       Model: 9000 Mobile-Met         System:  06
  Length:      33.0 (cm)  Width:       25.4 (cm)   Height:  15.2 (cm)
  Diameter:     0.0 (cm)  Volume:   12740.6 (cm3)  Weight:   3.60 (kg)
  Low Range:    0.0       High Range:   360.0 deg
  Accuracy:     5.00 deg                  Refresh Rate:
  Sensor type:
  Power consumption: 6-12 AA, 12-18 VDC         Moving parts: Yes


Climatronics              Model: METRAC                   System:  04
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  83.3 (cm)
  Diameter:    10.0 (cm)  Volume:    6542.4 (cm3)  Weight:   5.00 (kg)
  Low Range:    0.0       High Range:   360.0 deg
  Accuracy:     5.00 deg                  Refresh Rate: N/A
  Sensor type: IREMBAS COTS Wx Module
  Power consumption: 12 V or rechargeable bat.  Moving parts: Yes


METOCEAN                  Model: Ice Beacon               System:  04
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  31.0 (cm)
  Diameter:    54.0 (cm)  Volume:   70997.0 (cm3)  Weight:  20.00 (kg)
  Low Range:    0.0       High Range:   355.0 deg
  Accuracy:     5.00 deg                  Refresh Rate:
  Sensor type: Data sent to ARGOS
  Power consumption: 5 - 17.6 V battery         Moving parts: Yes
```

Equipment by Requirement Category

==========

Reference: 3.1.1.54b Wind, surface, direction
Required Accuracy: 10 deg
Required Refresh Rate: 15 (min)

==========

Scientific Sales Model: Wind Monitor-JR System: 02
Length: 33.0 (cm) Width: 31.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 1023.0 (cm3) Weight: .45 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 6.00 deg Refresh Rate:
Sensor type: vane
Power consumption: 15 VDC Moving parts: Yes

Davis Instruments Model: Weather Monitor II System: 06
Length: 13.3 (cm) Width: 14.9 (cm) Height: 7.7 (cm)
Diameter: 0.0 (cm) Volume: 1525.9 (cm3) Weight: .50 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 7.00 deg Refresh Rate: N/A
Sensor type: flat vane
Power consumption: AC with battery backup Moving parts: Yes

Davis Instruments Model: Weather Wizard III System: 05
Length: 13.3 (cm) Width: 14.9 (cm) Height: 7.7 (cm)
Diameter: 0.0 (cm) Volume: 1525.9 (cm3) Weight: .50 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 7.00 deg Refresh Rate: N/A
Sensor type:
Power consumption: AC with battery backup Moving parts: Yes

NovaLynx Model: 110-WS-12 Wind Station System: 03
Length: 9.7 (cm) Width: 16.0 (cm) Height: 3.6 (cm)
Diameter: 0.0 (cm) Volume: 558.7 (cm3) Weight: 1.36 (kg)
Low Range: 0.0 High Range: 360.0 deg
Accuracy: 7.50 deg Refresh Rate:
Sensor type:
Power consumption: Parallel Port Interface Moving parts: Yes

TX Wx Inst Inc Model: Weather Report System System: 04
Length: 31.0 (cm) Width: 15.2 (cm) Height: 8.9 (cm)
Diameter: 0.0 (cm) Volume: 4193.7 (cm3) Weight: 22.50 (kg)
Low Range: High Range:
Accuracy: 16.00 points Refresh Rate: instantenous
Sensor type: flat vane
Power consumption: RS 232 adapter Moving parts: Yes

```
==========================================================================
Reference: 3.1.1.54b   Wind, surface, direction
      Required Accuracy: 10 deg
      Required Refresh Rate:   15 (min)
==========================================================================
--------------------------------------------------------------------------

==========================================================================
Reference: 3.1.1.57a   Wind, upper air, speed
      Required Accuracy: 1 kt
      Required Refresh Rate:   15 (min)
==========================================================================

AIR (Atmo Inst Rsch)   Model: IS-4A series              System:  04
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   1.0 (cm)
  Diameter:      0.0 (cm)  Volume:       0.0 (cm3)  Weight:    .22 (kg)
  Low Range:               High Range:
  Accuracy:                                  Refresh Rate:
  Sensor type: radiosonde
  Power consumption: 80-200 VAC, 12V battery    Moving parts: No

--------------------------------------------------------------------------


==========================================================================
Reference: 3.1.1.57c   Wind, upper air, direction
      Required Accuracy: 10 deg
      Required Refresh Rate:   15 (min)
==========================================================================

AIR (Atmo Inst Rsch)   Model: IS-4A series              System:  05
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   1.0 (cm)
  Diameter:      0.0 (cm)  Volume:       0.0 (cm3)  Weight:    .22 (kg)
  Low Range:               High Range:
  Accuracy:                                  Refresh Rate:
  Sensor type: radiosonde
  Power consumption: 80-200 VAC, 12V battery    Moving parts: No

--------------------------------------------------------------------------
```

Reference: 3.1.2.01 Water depth
Required Accuracy: N/S
Required Refresh Rate: (min)

NovaLynx Model: 5050LL-PTK series System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 9.0 (cm)
Diameter: 2.5 (cm) Volume: 45.6 (cm3) Weight: .20 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type: Pressure Transducer
Power consumption: 10 - 40 VDC Moving parts: No

Handar Model: 451A/B/C System: 00
Length: 7.9 (cm) Width: 12.7 (cm) Height: 7.9 (cm)
Diameter: 0.0 (cm) Volume: 792.6 (cm3) Weight: .82 (kg)
Low Range: 0.0 High Range: 200.0
Accuracy: .01 % Refresh Rate:
Sensor type:
Power consumption: 6 to 25 VDC Moving parts: No

Handar Model: 436A/A-1 System: 00
Length: 17.8 (cm) Width: 12.7 (cm) Height: 10.2 (cm)
Diameter: 0.0 (cm) Volume: 2305.8 (cm3) Weight: 1.13 (kg)
Low Range: High Range:
Accuracy: .01 ft Refresh Rate:
Sensor type: Solid state incremental shaft encoder
Power consumption: <500 micro amps Moving parts: Yes

Handar Model: 436B System: 00
Length: 17.8 (cm) Width: 12.7 (cm) Height: 10.2 (cm)
Diameter: 0.0 (cm) Volume: 2305.8 (cm3) Weight: 1.13 (kg)
Low Range: -327.6 High Range: 327.6 ft
Accuracy: .01 ft Refresh Rate:
Sensor type: absolute reading shaft encoder
Power consumption: <650 micro amps Moving parts: Yes

Paroscientific Model: 8B series Depth sensor System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 10.5 (cm)
Diameter: 4.1 (cm) Volume: 137.7 (cm3) Weight: 1.32 (kg)
Low Range: 0.0 High Range: 6000.0 psia
Accuracy: .02 % Refresh Rate:
Sensor type: Digiquartz electrically isolated
Power consumption: 9 VDC Moving parts: No

Equipment by Requirement Category

Reference: 3.1.2.01 Water depth
Required Accuracy: N/S
Required Refresh Rate: (min)

EASI Model: EZ250 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 6.0 (cm)
Diameter: 2.5 (cm) Volume: 29.4 (cm3) Weight: .10 (kg)
Low Range: 5.0 High Range: 900.0 psi
Accuracy: .08 % Refresh Rate:
Sensor type:
Power consumption: 10/5 VDC Moving parts: No

NovaLynx Model: DCU-7 Ultrasonic Lev Sen System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 13.3 (cm)
Diameter: 6.0 (cm) Volume: 376.0 (cm3) Weight: 0.00 (kg)
Low Range: High Range:
Accuracy: .10 % Refresh Rate:
Sensor type: Ultrasonic Level Sensor
Power consumption: 12 - 24 VDC Moving parts: No

Handar Model: 449 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 22.0 (cm)
Diameter: 1.8 (cm) Volume: 56.0 (cm3) Weight: .11 (kg)
Low Range: 5.0 High Range: 900.0 psi
Accuracy: .10 % Refresh Rate:
Sensor type:
Power consumption: 12 VDC non Moving parts: No

NovaLynx Model: 280-320 Pres Transducer System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 9.0 (cm)
Diameter: 2.5 (cm) Volume: 45.6 (cm3) Weight: 1.10 (kg)
Low Range: 0.0 High Range: 250.0 psig
Accuracy: .25 % Refresh Rate:
Sensor type: Silicon pressure cell
Power consumption: 20 mA, 10-40 VDC Moving parts: No

Hydrolab Model: H2O System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 46.2 (cm)
Diameter: 8.9 (cm) Volume: 2874.2 (cm3) Weight: 3.36 (kg)
Low Range: 0.0 High Range: 100.0 m
Accuracy: .45 m Refresh Rate: < 1 min
Sensor type: strain-gauge transducer
Power consumption: Moving parts: No

Equipment by Requirement Category

Reference: 3.1.2.01 Water depth
Required Accuracy: N/S
Required Refresh Rate: (min)

NovaLynx Model: 5096EL-FT System: 00
Length: 10.2 (cm) Width: 25.4 (cm) Height: 17.8 (cm)
Diameter: 0.0 (cm) Volume: 4611.6 (cm3) Weight: 3.63 (kg)
Low Range: High Range:
Accuracy: 1.00 % of incrmnt Refresh Rate:
Sensor type: float
Power consumption: 250 micro amps Moving parts: Yes

Endeco/YSI Model: YSI 6000 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 48.3 (cm)
Diameter: 8.9 (cm) Volume: 3004.8 (cm3) Weight: 3.00 (kg)
Low Range: 0.0 High Range: 500.0 ft
Accuracy: 1.50 ft Refresh Rate:
Sensor type:
Power consumption: 12 VDC, or 8 alk C cells Moving parts: No

NovaLynx Model: 6535 Water Level Recorde System: 00
Length: 12.7 (cm) Width: 30.5 (cm) Height: 21.6 (cm)
Diameter: 0.0 (cm) Volume: 8366.8 (cm3) Weight: 7.70 (kg)
Low Range: High Range:
Accuracy: 2.50 mm Refresh Rate:
Sensor type: counterbalanced float
Power consumption: 2 LiMg batteries Moving parts: Yes

Sippican Inc Model: XCTD System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 99.8 (cm)
Diameter: 7.6 (cm) Volume: 4527.4 (cm3) Weight: 2.50 (kg)
Low Range: 0.0 High Range: 1000.0 meters
Accuracy: 5.00 m Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

Equipment by Requirement Category

```
==================================================================
Reference: 3.1.3.01    Surface temperature (water)
      Required Accuracy: 1 deg C
      Required Refresh Rate:   60 (min)
==================================================================

METOCEAN              Model: Ice Platform              System:  03
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height: 350.0 (cm)
  Diameter:    69.0 (cm)  Volume: 1308751.3 (cm3)  Weight: 250.00 (kg)
  Low Range:              High Range:
  Accuracy:                                 Refresh Rate:
  Sensor type: TOGA style drifter (ARGOS)
  Power consumption: Battery                    Moving parts: Yes


METOCEAN              Model: CMOD                      System:  03
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  91.4 (cm)
  Diameter:    12.2 (cm)  Volume:   10684.6 (cm3)  Weight:  12.73 (kg)
  Low Range:    -5.0      High Range:    35.0 deg C
  Accuracy:      .16 deg C                  Refresh Rate:
  Sensor type: ARGOS Drifting buoy (ARGOS)
  Power consumption: 5 - 17.6 V battery         Moving parts: Yes


Scientific Sales      Model: 4486                      System:  00
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:    .3 (cm)
  Diameter:     1.0 (cm)  Volume:         .2 (cm3)  Weight:    .10 (kg)
  Low Range:  -30.0       High Range:    50.0 deg C
  Accuracy:      .30 deg C                  Refresh Rate: .3 sec
  Sensor type: 2 element composite thermistor
  Power consumption:                            Moving parts: No


METOCEAN              Model: WOCE Drifter              System:  02
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  20.0 (cm)
  Diameter:     3.8 (cm)  Volume:     227.0 (cm3)  Weight:    .45 (kg)
  Low Range:              High Range:
  Accuracy:     1.00 deg C                 Refresh Rate:
  Sensor type: Lagrangian Drifter (ARGOS)
  Power consumption: Battery                    Moving parts: No


METOCEAN              Model: CALIB                     System:  02
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  91.4 (cm)
  Diameter:    12.4 (cm)  Volume:   11037.7 (cm3)  Weight:   8.00 (kg)
  Low Range:  -40.0       High Range:    11.0 deg C
  Accuracy:     1.00 deg C                 Refresh Rate:
  Sensor type: Data sent to ARGOS
  Power consumption: 5 - 17.6 V battery         Moving parts: No
```

Equipment by Requirement Category

```
======================================================================
Reference: 3.1.3.01    Surface temperature (water)
      Required Accuracy: 1 deg C
      Required Refresh Rate:   60 (min)
======================================================================

METOCEAN                Model: Ice Beacon                 System:  05
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  31.0 (cm)
  Diameter:    54.0 (cm)  Volume:   70997.0 (cm3)  Weight:  20.00 (kg)
  Low Range:  -25.5       High Range:     0.0 deg C
  Accuracy:     1.00 deg C                 Refresh Rate:
  Sensor type: Data sent to ARGOS
  Power consumption: 5 - 17.6 V battery         Moving parts: Yes


METOCEAN                Model: Standard Drifter           System:  04
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height: 350.0 (cm)
  Diameter:    69.0 (cm)  Volume: 1308751.3 (cm3)  Weight:  95.00 (kg)
  Low Range:   -5.0       High Range:    35.0 deg C
  Accuracy:     1.00 deg C                 Refresh Rate:
  Sensor type: (TIROS/ARGOS)
  Power consumption: Alkaline Bat (5-17.6V)     Moving parts: No

----------------------------------------------------------------------


======================================================================
Reference: 3.1.3.02    Temperature profile
      Required Accuracy: N/S
      Required Refresh Rate:      (min)
======================================================================

Sippican Inc            Model: XCTD                       System:  02
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  99.8 (cm)
  Diameter:     7.6 (cm)  Volume:    4527.4 (cm3)  Weight:   2.50 (kg)
  Low Range:   -2.2       High Range:    30.0 deg C
  Accuracy:      .03 deg C                  Refresh Rate:
  Sensor type: temperature-cycled thermistor
  Power consumption:                            Moving parts: No


Sippican Inc            Model: SSXBT                      System:  00
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  99.8 (cm)
  Diameter:     7.6 (cm)  Volume:    4527.4 (cm3)  Weight:   2.50 (kg)
  Low Range:   -2.2       High Range:    35.6 deg C
  Accuracy:      .15 deg C                  Refresh Rate:
  Sensor type:
  Power consumption:                            Moving parts: Yes
```

Equipment by Requirement Category

```
======================================================================
Reference: 3.1.3.02    Temperature profile
      Required Accuracy: N/S
      Required Refresh Rate:      (min)
======================================================================

Sippican Inc            Model: XBT / XSV                System:  01
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  99.8 (cm)
  Diameter:      7.6 (cm)  Volume:    4527.4 (cm3)  Weight:   2.50 (kg)
  Low Range:    -2.2       High Range:    35.6 deg C
  Accuracy:      .15 deg C                 Refresh Rate:
  Sensor type:
  Power consumption:                          Moving parts: Yes


Sippican Inc            Model: XCP                      System:  01
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  99.8 (cm)
  Diameter:      7.6 (cm)  Volume:    4527.4 (cm3)  Weight:   2.50 (kg)
  Low Range:               High Range:
  Accuracy:      3.00 % RMS                Refresh Rate:
  Sensor type:
  Power consumption:                          Moving parts: No

----------------------------------------------------------------------


======================================================================
Reference: 3.1.3.03    Water turbidity/visibility
      Required Accuracy: 1 m
      Required Refresh Rate:   60 (min)
======================================================================

Li-Cor                  Model: LI-193SA                 System:  00
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:  10.7 (cm)
  Diameter:      3.2 (cm)  Volume:      85.0 (cm3)  Weight:    .14 (kg)
  Low Range:   400.0       High Range:   700.0 nm
  Accuracy:                              Refresh Rate: 10 micro sec
  Sensor type: silicon photovoltaic detector
  Power consumption:                          Moving parts: No


Li-Cor                  Model: LI-192SA                 System:  00
  Length:        0.0 (cm)  Width:        0.0 (cm)   Height:   4.6 (cm)
  Diameter:      3.2 (cm)  Volume:      36.7 (cm3)  Weight:    .23 (kg)
  Low Range:   400.0       High Range:   700.0 nm
  Accuracy:                              Refresh Rate: 10 micro sec
  Sensor type: silicon photovoltaic detector
  Power consumption:                          Moving parts: No
```

Equipment by Requirement Category

Reference: 3.1.3.03 Water turbidity/visibility
Required Accuracy: 1 m
Required Refresh Rate: 60 (min)

Li-Cor Model: LI-1800UW System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 28.0 (cm)
Diameter: 32.0 (cm) Volume: 22519.0 (cm3) Weight: 25.00 (kg)
Low Range: 0.0 High Range: 200.0 m
Accuracy: Refresh Rate:
Sensor type:
Power consumption: 6V NiCad bat Moving parts: No

NovaLynx Model: 210-500 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 30.5 (cm)
Diameter: 2.2 (cm) Volume: 115.9 (cm3) Weight: .45 (kg)
Low Range: 1.0 High Range: 2000.0 NTU
Accuracy: 2.00 % Refresh Rate:
Sensor type: insertion probe
Power consumption: 115V or 230VAC Moving parts: No

Hydrolab Model: Turbity Sensor System: 00
Length: 20.0 (cm) Width: 4.0 (cm) Height: 7.6 (cm)
Diameter: 0.0 (cm) Volume: 608.0 (cm3) Weight: 1.30 (kg)
Low Range: 0.0 High Range: 1000.0 NTU
Accuracy: 5.00 % of range Refresh Rate:
Sensor type: ISO 7027 nephelometric
Power consumption: Moving parts: No

Hydrolab Model: H2O System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 46.2 (cm)
Diameter: 8.9 (cm) Volume: 2874.2 (cm3) Weight: 3.36 (kg)
Low Range: 0.0 High Range: 1000.0 NTU
Accuracy: 5.00 % Refresh Rate: < 1 min
Sensor type: ISO 7027 nephelometric
Power consumption: Moving parts: No

Equipment by Requirement Category

Reference: 3.1.3.04 Temperature, water, inland
Required Accuracy: 1 deg C
Required Refresh Rate: 60 (min)

Climatronics Model: 100093-2 System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 11.4 (cm)
Diameter: .6 (cm) Volume: 3.7 (cm3) Weight: 0.00 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .10 deg C Refresh Rate: 3.6 SEC
Sensor type: thermistor bead expanded range
Power consumption: Moving parts: No

Climatronics Model: 100826 System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 15.2 (cm)
Diameter: .6 (cm) Volume: 4.9 (cm3) Weight: 0.00 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .10 deg C Refresh Rate: 5.5 SEC
Sensor type: Platinum 4-Wire
Power consumption: Moving parts: No

Climatronics Model: 100093 / 100093-1 System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 11.4 (cm)
Diameter: .6 (cm) Volume: 3.7 (cm3) Weight: 0.00 (kg)
Low Range: -33.0 High Range: 50.0 deg C
Accuracy: .15 deg C Refresh Rate: 3.6 SEC
Sensor type: thermistor bead
Power consumption: Moving parts: No

Climatronics Model: 100093-3 System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 11.4 (cm)
Diameter: .6 (cm) Volume: 3.7 (cm3) Weight: 0.00 (kg)
Low Range: -30.0 High Range: 50.0 deg C
Accuracy: .15 deg C Refresh Rate: .6 SEC
Sensor type: Fast Response
Power consumption: Moving parts: No

Handar Model: 460C System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 46.2 (cm)
Diameter: 8.9 (cm) Volume: 2874.2 (cm3) Weight: 3.36 (kg)
Low Range: -5.0 High Range: 50.0 deg C
Accuracy: .15 deg C Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

Equipment by Requirement Category

Reference: 3.1.3.04 Temperature, water, inland
Required Accuracy: 1 deg C
Required Refresh Rate: 60 (min)

Hydrolab Model: H2O System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 46.2 (cm)
Diameter: 8.9 (cm) Volume: 2874.2 (cm3) Weight: 3.36 (kg)
Low Range: -5.0 High Range: 50.0 deg C
Accuracy: .15 deg C Refresh Rate: < 1 min
Sensor type: thermistor
Power consumption: Moving parts: No

Scientific Sales Model: 4485 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.0 (cm)
Diameter: 1.3 (cm) Volume: 10.6 (cm3) Weight: .10 (kg)
Low Range: -30.0 High Range: 50.0 deg C
Accuracy: .20 deg C Refresh Rate: 1.4 min
Sensor type: 3 element composite thermistor
Power consumption: Moving parts: No

Scientific Sales Model: 4482 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 21.6 (cm)
Diameter: 5.1 (cm) Volume: 441.3 (cm3) Weight: .10 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .20 deg C Refresh Rate: 1.4 min
Sensor type: 3 element composite thermistor
Power consumption: Moving parts: No

NovaLynx Model: TP1 - TP4 System: 01
Length: 9.9 (cm) Width: 6.9 (cm) Height: 3.8 (cm)
Diameter: 0.0 (cm) Volume: 259.6 (cm3) Weight: 1.36 (kg)
Low Range: High Range:
Accuracy: .40 deg C Refresh Rate:
Sensor type:
Power consumption: 9 - 24 VDC Moving parts: No

Endeco/YSI Model: YSI 600 System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 35.6 (cm)
Diameter: 4.1 (cm) Volume: 470.0 (cm3) Weight: 2.20 (kg)
Low Range: -5.0 High Range: 45.0 deg C
Accuracy: .40 deg C Refresh Rate:
Sensor type:
Power consumption: 12 VDC Moving parts: No

Equipment by Requirement Category

```
==========================================================================
Reference: 3.1.3.04    Temperature, water, inland
      Required Accuracy: 1 deg C
      Required Refresh Rate:   60 (min)
==========================================================================

Endeco/YSI                Model: YSI 6000                  System:  02
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  48.3 (cm)
  Diameter:     8.9 (cm)  Volume:    3004.8 (cm3)  Weight:   3.00 (kg)
  Low Range:    -5.0      High Range:    45.0 deg C
  Accuracy:      .40 deg C                 Refresh Rate:
  Sensor type:
  Power consumption: 12 VDC, or 8 alk C cells   Moving parts: No


Climatronics              Model: EWS                       System:  09
  Length:      39.4 (cm)  Width:       78.1 (cm)   Height:  14.6 (cm)
  Diameter:     0.0 (cm)  Volume:   44926.2 (cm3)  Weight:  20.00 (kg)
  Low Range:  -30.0       High Range:    20.0 deg C
  Accuracy:      .50 deg C                 Refresh Rate: N/A
  Sensor type: thermistor
  Power consumption: AC/DC                      Moving parts: Yes

--------------------------------------------------------------------------


==========================================================================
Reference: 3.1.3.08    Water salinity
      Required Accuracy: N/S
      Required Refresh Rate:      (min)
==========================================================================

METOCEAN                  Model: Ice Platform              System:  04
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height: 350.0 (cm)
  Diameter:    69.0 (cm)  Volume: 1308751.3 (cm3)  Weight: 250.00 (kg)
  Low Range:              High Range:
  Accuracy:                                 Refresh Rate:
  Sensor type: TOGA style drifter (ARGOS)
  Power consumption: Battery                    Moving parts: Yes


Handar                    Model: 460C                      System:  02
  Length:       0.0 (cm)  Width:        0.0 (cm)   Height:  46.2 (cm)
  Diameter:     8.9 (cm)  Volume:    2874.2 (cm3)  Weight:   3.36 (kg)
  Low Range:    0.0       High Range:    70.0 ppt
  Accuracy:      .20 ppt                  Refresh Rate:
  Sensor type:
  Power consumption:                            Moving parts: No
```

Equipment by Requirement Category

Reference: 3.1.3.08 Water salinity
Required Accuracy: N/S
Required Refresh Rate: (min)

Hydrolab Model: H2O System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 46.2 (cm)
Diameter: 8.9 (cm) Volume: 2874.2 (cm3) Weight: 3.36 (kg)
Low Range: 0.0 High Range: 70.0 ppt
Accuracy: .20 ppt Refresh Rate: < 1 min
Sensor type: calculated from specific conductance
Power consumption: Moving parts: No

Endeco/YSI Model: YSI 600 System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 35.6 (cm)
Diameter: 4.1 (cm) Volume: 470.0 (cm3) Weight: 2.20 (kg)
Low Range: 0.0 High Range: 70.0 ppt
Accuracy: 2.00 % Refresh Rate:
Sensor type:
Power consumption: 12 VDC Moving parts: No

Endeco/YSI Model: YSI 6000 System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 48.3 (cm)
Diameter: 8.9 (cm) Volume: 3004.8 (cm3) Weight: 3.00 (kg)
Low Range: 0.0 High Range: 70.0 ppt
Accuracy: 2.00 % Refresh Rate:
Sensor type:
Power consumption: 12 VDC, or 8 alk C cells Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.1.4.02 Current speed, near-shore/littoral
Required Accuracy: 0.1 Kt (.0515 m/sec)
Required Refresh Rate: 60 (min)

==========

Scientific Sales Model: 6660 Qualimetrics System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 29.2 (cm)
Diameter: 9.5 (cm) Volume: 2069.8 (cm3) Weight: .29 (kg)
Low Range: 0.0 High Range: 6.0 m/s
Accuracy: Refresh Rate:
Sensor type: 4 blade propeller
Power consumption: 9 VDC rechargeable NiCd Moving parts: Yes

Qualimetrics Inc Model: 6660 Water Current Meter System: 01
Length: 0.0 (cm) Width: 0.0 (cm) Height: 29.2 (cm)
Diameter: 9.5 (cm) Volume: 2069.8 (cm3) Weight: 9.00 (kg)
Low Range: 0.0 High Range: 6.0 m/sec
Accuracy: Refresh Rate:
Sensor type: propeller driven photo-optical system
Power consumption: 9 Vdc recharg. NiCd bat Moving parts: Yes

NovaLynx Model: Global Flow Probe System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 7.6 (cm)
Diameter: 5.1 (cm) Volume: 155.3 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 8.0 m/s
Accuracy: .03 m/sec Refresh Rate:
Sensor type: Turbo-Prop propeller w/electromagnet p/u
Power consumption: watch type battery Moving parts: No

Swoffer Model: 2100 System: 01
Length: 15.2 (cm) Width: 10.2 (cm) Height: 5.1 (cm)
Diameter: 0.0 (cm) Volume: 790.7 (cm3) Weight: .60 (kg)
Low Range: .0 High Range: 7.5 m/sec
Accuracy: 1.00 % Refresh Rate: 1.5,6,or30 sec
Sensor type: PHOTO-FIBER-OPTIC
Power consumption: 9 V Battery Moving parts: Yes

NovaLynx Model: 6645 Pygmy Water Cur Met System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 25.4 (cm)
Diameter: 8.3 (cm) Volume: 1374.3 (cm3) Weight: 4.80 (kg)
Low Range: .1 High Range: 1.0 m/s
Accuracy: 2.00 % Refresh Rate:
Sensor type: 6 cup assembly, cone-shaped cups
Power consumption: two 1.5 VDC batteries Moving parts: Yes

Reference: 3.1.4.02 Current speed, near-shore/littoral
Required Accuracy: 0.1 Kt (.0515 m/sec)
Required Refresh Rate: 60 (min)

Reference: 3.2.1.03 Ice/snow depth
Required Accuracy: 1.25 cm
Required Refresh Rate: 60 (min)

METOCEAN Model: Ice Platform System: 05
Length: 0.0 (cm) Width: 0.0 (cm) Height: 350.0 (cm)
Diameter: 69.0 (cm) Volume: 1308751.3 (cm3) Weight: 250.00 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type: TOGA style drifter (ARGOS)
Power consumption: Battery Moving parts: Yes

Campbell Scientific Model: UDG01 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 23.0 (cm)
Diameter: 7.3 (cm) Volume: 962.6 (cm3) Weight: .90 (kg)
Low Range: .6 High Range: 10.0 m
Accuracy: 1.00 cm Refresh Rate: N/A
Sensor type: acoustic
Power consumption: 12VDC Moving parts: No

Equipment by Requirement Category

==========

Reference: 3.2.1.07 Soil/ground moisture
Required Accuracy: 5% of moisture content to depth 20 cm
Required Refresh Rate: 30 (min)

==========

NovaLynx Model: 250-110 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 5.1 (cm)
Diameter: 2.2 (cm) Volume: 19.4 (cm3) Weight: .22 (kg)
Low Range: 10.0 High Range: 200.0 cb
Accuracy: Refresh Rate:
Sensor type: 2 concentric electrodes
Power consumption: 12 VDC Moving parts: No

NovaLynx Model: 250-100 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 76.2 (cm)
Diameter: 2.5 (cm) Volume: 386.1 (cm3) Weight: .90 (kg)
Low Range: 0.0 High Range: 80.0 cb/kPascal
Accuracy: Refresh Rate:
Sensor type: tensiometer
Power consumption: 12 VDC or 120 VAC Moving parts: No

Handar Model: 438B System: 00
Length: 8.9 (cm) Width: 12.7 (cm) Height: 12.7 (cm)
Diameter: 0.0 (cm) Volume: 1435.5 (cm3) Weight: .95 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type: concentric electrodes in porous matrix
Power consumption: 9 TO 25 V, 6 mA Moving parts: No

NovaLynx Model: 3051 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 76.2 (cm)
Diameter: 2.5 (cm) Volume: 386.1 (cm3) Weight: 1.36 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type:
Power consumption: 12 VDC @ 30 mA Moving parts: No

==========

Reference: 3.2.1.08 Soil/ground temperature
Required Accuracy: 1 deg C
Required Refresh Rate: 30 (min)

==========

METOCEAN Model: Ice Platform System: 06
Length: 0.0 (cm) Width: 0.0 (cm) Height: 350.0 (cm)
Diameter: 69.0 (cm) Volume: 1308751.3 (cm3) Weight: 250.00 (kg)
Low Range: High Range:
Accuracy: Refresh Rate:
Sensor type: TOGA style drifter (ARGOS)
Power consumption: Battery Moving parts: Yes

Vaisala Model: DTS 12G System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 10.0 (cm)
Diameter: .8 (cm) Volume: 5.0 (cm3) Weight: .17 (kg)
Low Range: -100.0 High Range: 100.0 deg C
Accuracy: .08 deg C Refresh Rate:
Sensor type: Platinum resistance element
Power consumption: Moving parts: No

Climatronics Model: 100093-2 System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 11.4 (cm)
Diameter: .6 (cm) Volume: 3.7 (cm3) Weight: 0.00 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .10 deg C Refresh Rate: 3.6 SEC
Sensor type: thermistor bead expanded range
Power consumption: Moving parts: No

Climatronics Model: 100826 System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 15.2 (cm)
Diameter: .6 (cm) Volume: 4.9 (cm3) Weight: 0.00 (kg)
Low Range: -50.0 High Range: 50.0 deg C
Accuracy: .10 deg C Refresh Rate: 5.5 SEC
Sensor type: Platinum 4-Wire
Power consumption: Moving parts: No

Handar Model: 433F/FN System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 15.2 (cm)
Diameter: 1.3 (cm) Volume: 18.7 (cm3) Weight: .63 (kg)
Low Range: -50.0 High Range: 60.0 deg C
Accuracy: .10 deg C Refresh Rate:
Sensor type: Thermistor temperature element
Power consumption: Moving parts: No

Equipment by Requirement Category

Reference: 3.2.1.08 Soil/ground temperature
Required Accuracy: 1 deg C
Required Refresh Rate: 30 (min)

Climatronics Model: 100093 / 100093-1 System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 11.4 (cm)
Diameter: .6 (cm) Volume: 3.7 (cm3) Weight: 0.00 (kg)
Low Range: -33.0 High Range: 50.0 deg C
Accuracy: .15 deg C Refresh Rate: 3.6 SEC
Sensor type: thermistor bead
Power consumption: Moving parts: No

Climatronics Model: 100093-3 System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 11.4 (cm)
Diameter: .6 (cm) Volume: 3.7 (cm3) Weight: 0.00 (kg)
Low Range: -30.0 High Range: 50.0 deg C
Accuracy: .15 deg C Refresh Rate: .6 SEC
Sensor type: Fast Response
Power consumption: Moving parts: No

Scientific Sales Model: 4485 System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 8.0 (cm)
Diameter: 1.3 (cm) Volume: 10.6 (cm3) Weight: .10 (kg)
Low Range: -30.0 High Range: 50.0 deg C
Accuracy: .20 deg C Refresh Rate: 1.4 min
Sensor type: 3 element composite thermistor
Power consumption: Moving parts: No

NovaLynx Model: TP1 - TP4 System: 02
Length: 9.9 (cm) Width: 6.9 (cm) Height: 3.8 (cm)
Diameter: 0.0 (cm) Volume: 259.6 (cm3) Weight: 1.36 (kg)
Low Range: High Range:
Accuracy: .40 deg C Refresh Rate:
Sensor type:
Power consumption: 9 - 24 VDC Moving parts: No

Climatronics Model: EWS System: 10
Length: 39.4 (cm) Width: 78.1 (cm) Height: 14.6 (cm)
Diameter: 0.0 (cm) Volume: 44926.2 (cm3) Weight: 20.00 (kg)
Low Range: -30.0 High Range: 20.0 deg C
Accuracy: .50 deg C Refresh Rate: N/A
Sensor type: thermistor
Power consumption: AC/DC Moving parts: Yes

Equipment by Requirement Category

Reference: 3.2.1.08 Soil/ground temperature
Required Accuracy: 1 deg C
Required Refresh Rate: 30 (min)

EASI Model: EZ350 System: 00
Length: 0.0 (cm) Width: 0.0 (cm) Height: 1.0 (cm)
Diameter: 0.0 (cm) Volume: 0.0 (cm3) Weight: 0.00 (kg)
Low Range: -50.0 High Range: 75.0 deg C
Accuracy: 2.00 deg C Refresh Rate:
Sensor type: mini-thermistor
Power consumption: Moving parts: No

Reference: 3.2.2.07 River depth
Required Accuracy: N/S
Required Refresh Rate: (min)

Hydrolab Model: H2O System: 05
Length: 0.0 (cm) Width: 0.0 (cm) Height: 46.2 (cm)
Diameter: 8.9 (cm) Volume: 2874.2 (cm3) Weight: 3.36 (kg)
Low Range: 0.0 High Range: 100.0 m
Accuracy: .45 m Refresh Rate: < 1 min
Sensor type: strain-gauge transducer
Power consumption: Moving parts: No

Equipment by Requirement Category

Reference: 3.2.2.16 River flow speed
Required Accuracy: 0.1 Kt (.0515 m/sec)
Required Refresh Rate: 30 (min)

Qualimetrics Inc Model: 6660 Water Current Meter System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 29.2 (cm)
Diameter: 9.5 (cm) Volume: 2069.8 (cm3) Weight: 9.00 (kg)
Low Range: 0.0 High Range: 6.0 m/sec
Accuracy: Refresh Rate:
Sensor type: propeller driven photo-optical system
Power consumption: 9 Vdc recharg. NiCd bat Moving parts: Yes

Swoffer Model: 2100 System: 02
Length: 15.2 (cm) Width: 10.2 (cm) Height: 5.1 (cm)
Diameter: 0.0 (cm) Volume: 790.7 (cm3) Weight: .60 (kg)
Low Range: .0 High Range: 7.5 m/sec
Accuracy: 1.00 % Refresh Rate: 1.5,6,or30 sec
Sensor type: PHOTO-FIBER-OPTIC
Power consumption: 9 V Battery Moving parts: Yes

Sippican Inc Model: XCP System: 02
Length: 0.0 (cm) Width: 0.0 (cm) Height: 99.8 (cm)
Diameter: 7.6 (cm) Volume: 4527.4 (cm3) Weight: 2.50 (kg)
Low Range: High Range:
Accuracy: 3.00 % RMS Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

Reference: 3.2.2.17 River flow direction
Required Accuracy: up/down river
Required Refresh Rate: 30 (min)

Sippican Inc Model: XCP System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 99.8 (cm)
Diameter: 7.6 (cm) Volume: 4527.4 (cm3) Weight: 2.50 (kg)
Low Range: High Range:
Accuracy: 3.00 % RMS Refresh Rate:
Sensor type:
Power consumption: Moving parts: No

Reference: 3.2.2.19 River temperature
Required Accuracy: N/S
Required Refresh Rate: (min)

Hydrolab Model: H2O System: 06
Length: 0.0 (cm) Width: 0.0 (cm) Height: 46.2 (cm)
Diameter: 8.9 (cm) Volume: 2874.2 (cm3) Weight: 3.36 (kg)
Low Range: -5.0 High Range: 50.0 deg C
Accuracy: .15 deg C Refresh Rate: < 1 min
Sensor type: thermistor
Power consumption: Moving parts: No

Endeco/YSI Model: YSI 600 System: 03
Length: 0.0 (cm) Width: 0.0 (cm) Height: 35.6 (cm)
Diameter: 4.1 (cm) Volume: 470.0 (cm3) Weight: 2.20 (kg)
Low Range: -5.0 High Range: 45.0 deg C
Accuracy: .40 deg C Refresh Rate:
Sensor type:
Power consumption: 12 VDC Moving parts: No

Endeco/YSI Model: YSI 6000 System: 04
Length: 0.0 (cm) Width: 0.0 (cm) Height: 48.3 (cm)
Diameter: 8.9 (cm) Volume: 3004.8 (cm3) Weight: 3.00 (kg)
Low Range: -5.0 High Range: 45.0 deg C
Accuracy: .40 deg C Refresh Rate:
Sensor type:
Power consumption: 12 VDC, or 8 alk C cells Moving parts: No

APPENDIX C- VENDOR/PROVIDER ADDRESSES

See attached forms

Companies

AIR (Atmospheric Instrumentation Research)
8401 Baseline Road
Boulder, CO 80303
Phone: 303-499-1701 Fax: 303-499-1767

Air Resource Specialists Incc
1901 Sharp Point Dr.
Suite E
Fort Collins, CO 80525
Phone: 303-484-7941 Fax: 303-484-3423

Applied Technologies Inc.
6395 Gunpark Drive
Unit E
Boulder, CO 80301
Phone: 303-530-4977 Fax: 303-530-4982

Campbell Scientific
815 W. 1800 N.
Logan, UT 84321
Phone: 801-753-2342 Fax: 801-752-3268

Climatronics
140 Wilber Place
Airport International Plaza
Bohemia, NY 11716
Phone: 516-567-7300 Fax: 516-567-7585

Davis Instruments
3465 Diablo Ave.
Hayward, CA 94545
Phone: 800-678-3669 Fax:

EASI
PO Box 986
Dayton, OH 45401
Phone: 800-543-9930 Fax: 513-859-7930

Endeco/YSI
13 Atlantis Drive
Marion, MA 02738
Phone: 800-363-3269 Fax: 508-748-2543

Handar
1288 Reamwood Avenue
Sunnyvale, CA 94089-2233
Phone: 800-955-7367 Fax: 408-734-0655

Hydrolab
P.O. Box 50116
Austin, TX 78763
Phone: 800-949-3766 Fax: 512-255-3106

Li-Cor
4421 Superior Street
PO Box 4425
Lincoln, NE 68504
Phone: 800-447-3576 Fax: 402-467-2819

MET ONE
1600 Washington Blvd.
Grants Pass, OR 97526
Phone: 503-471-7111 Fax: 503-471-7116

METOCEAN
Suite 100
724 Dulaney Valley Road
Townson, MD 21204
Phone: 410-377-3110 Fax: 410-377-3111

MesoTech International
4670 Chancery Way
Sacramento, CA 95864
Phone: 916-483-0600 Fax: 916-483-0700

NovaLynx
PO Box 240
Grass Valley, CA 95945
Phone: 916-477-5226 Fax: 916-477-8339

Companies

Paroscientific
4500 148th Ave N.E.
Redmond, WA 98052
Phone: 206-883-8700 Fax: 206-867-5407

Qualimetrics Inc.
1165 National Dr.
Sacramento, CA 95834
Phone: 800-824-5873 Fax: 916-928-1165

REMTECH
PO Box 2423
Longmont, CO 80502
Phone: 303-772-6825 Fax: 303-772-6827

Radian
2990 Center Green St.
Boulder, CO 80301
Phone: 303-443-2378 Fax: 303-443-1628

Scientific Sales
PO Box 6725
Lawrenceville, NJ 08648
Phone: 609-844-0055 Fax: 609-844-0466

Scintec
Panoramastrasse 67
D-7406 Mossingen 5, Germany
Phone: 074-732-3886 Fax: 074-732-3746

Sippican Inc
Seven Barnabas Road
Marion, MA 02738-1499
Phone: 508-748-1160 Fax: 508-748-3626

Surface Systems Inc

Phone: Fax:

Swoffer
1048 Industry Dr.
Seattle, WA 98188
Phone: 206-575-0160 Fax: 206-575-1329

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Texas Electronics Inc.
PO Box 7225
Dallas, TX 75209
Phone: 800-424-5651 Fax: 214-631-4218

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Texas Weather Instrumentation Inc.
PO Box 240
Grass Valley, CA 95945-0240
Phone: 916-477-5226 Fax: 916-477-8339

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Teledyne Geotech
PO Box 469007
Garland, TX 75046-9007
Phone: 214-271-2561 Fax:

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VIZ (ZEEMET)
335 East Price St
Phiiadelphia, PA 19144-5782
Phone: 215-844-2626 Fax: 215-844-4410

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Vaisala
100 Commerce Way
Woburn, MA 01801
Phone: 617-933-4500 Fax: 617-933-8029

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Weather Port
PO Box 240
Grass Valley, CA 95945
Phone: 916-477-5226 Fax: 916-477-8339

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WeatherPort NovaLynx
PO Box 240
Grass Valley, CA 95945
Phone: 916-477-5226 Fax: 916-477-8339

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R. M. Young Company
2801 Aero-Park Drive
Traverse City, MI 49684
Phone: 616-946-3980 Fax: 616-946-4772

APPENDIX D - REFERENCES AND BIBLIOGRAPHY

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Curtin, Thomas B., James G. Bellingham, Josko Catipovic and Doug Webb. Autonomous Oceanographic Sampling Networks. Oceanography Vol. 6 No. 3, 1993.

Hartsough, Craig S., Downslope Windstorm Analysis Using the Local Analysis and Prediction System (LAPS), NOAA Forecast Systems Laboratory, Boulder, Colorado, 80303; Visiting Scientist of the National Research Council, Washington, D.C. 20418, October, 1992

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McGinley, John A. The Local Analysis and Prediction System; NOAA/ERL/Forecast Systems Lab Program for Regional Observing and Forecasting Services (PROFS) Boulder, Colorado; October 1989

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